PENCOYD IRON WORKS
A. & P. ROBERTS & CO.
PHILADELPHIA,
PA.

WROUGHT IRON AND STEEL IN CONSTRUCTION

1892

75

Franklin Institute Library
PHILADELPHIA

Class 672 Book R54
ed 8

Accession 70246

REFERENCE

GIVEN BY

Mr. George R. Henderson

G R Henderson
1892.

OPEN-HEARTH FURNACES. ROLLING MILLS. ROLLING MILLS. MACHINE SHOP. BRIDGE AND CONSTRUCTION DEPARTMENT.

PENCOYD IRON WORKS.

Situated at Pencoyd, Pa., on Schuylkill River, near Philadelphia, Pa.

#75

Wrought Iron and Steel

IN CONSTRUCTION.

CONVENIENT RULES, FORMULÆ, AND TABLES FOR THE STRENGTH OF WROUGHT IRON AND STEEL SHAPES USED AS BEAMS, STRUTS, SHAFTS, ETC.

MADE BY

THE PENCOYD IRON WORKS.

A. & P. ROBERTS & CO.

IRON AND STEEL DEPARTMENT,

MANUFACTURERS OF OPEN HEARTH STEEL AND WROUGHT IRON, SHAPES, BARS, FORGINGS, SHAFTING, HAMMERED AXLES AND STRUCTURAL MATERIAL.

BRIDGE AND CONSTRUCTION DEPARTMENT,

DESIGNERS AND MANUFACTURERS OF RAILROAD BRIDGES, VIADUCTS, TURN-TABLES, AND ALL CLASSES OF STRUCTURES OF IRON OR STEEL.

EIGHTH EDITION.

1892.

OFFICE:

261 SOUTH FOURTH STREET,

PHILADELPHIA, PA.

Copyright, 1892,

A. & P. ROBERTS & CO.

PRESS OF
GLOBE PRINTING HOUSE,
PHILADELPHIA.

THE GETTY CENTER
LIBRARY

PREFACE TO EIGHTH EDITION.

Since the first edition of "Wrought Iron and Steel in Construction" was issued in the year 1884, such radical changes in Engineering practice have occurred that it has been necessary to alter very materially the product of the Manufacturer of Iron and Steel to meet the new requirements of the Engineer.

Steel is yearly being used in increasing quantities, requiring additions to plant for the production of all sections and sizes of the same. It has, therefore, been found necessary to entirely rewrite the present edition, enlarging the Tables to embrace steel as well as iron, and enabling us to add much additional matter which, we believe, will be found useful in daily practice. A large number of new sections in both Iron and Steel have been added to our list, which now embraces a practically complete set of shapes and sizes of both materials. As heretofore, the subjects have been confined entirely to the output of our own Works, referring to the numerous Engineering Handbooks for data upon other topics.

The text and tables have been very carefully prepared under the supervision of Mr. James Christie, and we trust may be of value to all who have occasion to use the product of the Pencoyd Iron Works.

A. & P. Roberts & Co.

Pencoyd, April 15, 1892.

70246

CONTENTS.

	PAGES
SIZES AND WEIGHTS OF ROLLED SHAPES	1-20
WEIGHTS OF BARS AND SHEETS	21-32
STEEL AXLES	33
PROPERTIES OF IRON AND STEEL	34-38
DESCRIPTION OF BEAM TABLES	39-43
TABLES FOR I BEAMS	45-97
TABLES FOR CHANNEL AND DECK BEAMS	98-105
FLOOR BEAMS	106-110
BUCKLED PLATES	111-113
CORRUGATED FLOORING	114-118
GENERAL FORMULÆ FOR ROLLED BEAMS	119-125
BENDING MOMENTS AND DEFLECTIONS	126-129
COMPOUND STRAINS ON BEAMS	130-135
RIVETED GIRDERS	136-148
ELEMENTS OF ROLLED SECTIONS	149-171
MOMENTS OF INERTIA, RESISTANCE, ETC.	172-179
STRUTS OF IRON AND STEEL	180-187
ROLLED SHAPES AS STRUTS	188-201
LATTICED CHANNEL COLUMNS	202-205
ROUND AND SQUARE COLUMNS	206-215
STRESSES IN STRUCTURES	216-221
SHAFTING	222-229
PINS AND RIVETS	230-237
EYE BARS, CLEVISES, TURNBUCKLES, ETC.	238-243
BOLTS—CHAIN, ETC.	244-249
PROPERTIES OF CIRCLES	251-257

For complete detail of Contents see Index.

Rolled Shapes of Iron and Steel.

PART I.

TABLES OF DIMENSIONS.

The lithographs and following tables give the principal dimensions of the standard shapes of structural iron and steel rolled at Pencoyd.

Beams and channels can be rolled of any intermediate sections between the minimum and maximum. The web is thickened, which increases the width of the flange, but does not change any other dimension of the flange. The position of the added area is shown on Plate No. 43.

Angles can be rolled of any thickness between minimum and maximum. Weights corresponding to the principal intermediate thicknesses are given in tables on pages 10, 11, 12 and 13. The legs of angles increase slightly in length as the thickness increases, as described on page 18. This sometimes causes angles of heavy sections to vary from the calculated weights. Therefore orders should specify either the desired thickness or weight per foot, but not both.

Tee sections cannot be altered from the standards as given in tables and lithographs.

Bars and *Miscellaneous Shapes* can be rolled in either steel or iron.

Sections which cannot be rolled of both iron and steel are so noted on the lithograph plates. The weights given for sections which can be rolled of either iron or steel, are for iron unless otherwise stated, and when these sections are rolled in steel the weight will be about 2 per cent. heavier.

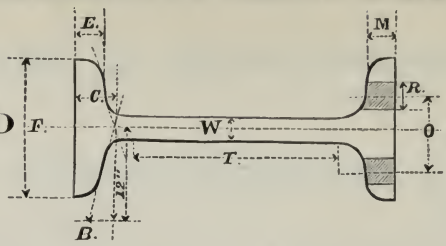
PENCOYD IRON I BEAMS.

Chart Number.	Depth in Inches.	Least Web Thickness.	Least Weight per Foot in Pounds.	Approximate Weight in Pounds per Foot for each Thickness of Web, in Inches.									Increased Thickness in Inches for each Additional Pound per Foot.
				1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	
1	15	9/16	63.43						63.43	66.55	72.80	79.05	.020
2	15	7/16	49.33				49.33	52.45	55.58	58.70			
3	12	21/32	57.06								60.81	65.8	.025
4	12	23/64	40.10					41.97	44.47	46.97			
5	10½	15/32	45.10					46.19	48.37	50.56			.029
5½	10½	13/32	36.53				37.62	39.81	42.00	44.19			
6	10½	11/32	30.00			31.09	33.27	35.45					
7	10	1/2	37.50					37.50	39.58	41.66	45.83		.030
8	10	11/32	30.46			31.50	33.58	35.46					
9	9	13/32	30.93				31.87	33.74	35.61				.033
10	9	5/16	23.93		23.93	25.83	27.73	29.63					
11	8	13/32	27.53				28.36	30.03	31.70				.037
12	8	19/64	20.80		21.21	22.85	24.49	26.13					
13	7	7/16	22.26				22.26	23.67					.042
14	7	15/64	17.53	17.89	19.33	20.77	22.21						
15	6	9/32	18.83		19.46	20.73	22.01	23.28	24.55	25.83			.050
16	6	7/32	13.66	14.28	15.54	16.80	18.06						
23	6	5/8	39.30							39.30	41.80	44.30	
24	6	1/2	30.90					30.90	32.15	33.40	35.90		
17	5	17/64	10.10		10.88	11.93							.060
19	4	7/32	8.33	8.75	9.59	10.42	11.26						.075
20	4	5/32	6.13	7.33	8.13								
21	3	7/32	6.86	7.17	7.80	8.43	9.06						.100
22	3	5/32	5.26	6.16	6.76								

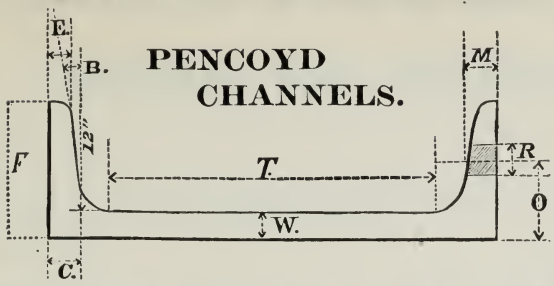
PENCOYD STEEL I BEAMS.

Chart Number.	Depth in Inches.	Least Web Thickness.	Least Weight per Foot in Pounds.	Approximate Weight in Pounds per Foot for each Thickness of Web, in Inches.								Increased Thickness in Inches for each Additional Pound per Foot.
				1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	
521	15	13/32	43.29				43.88	46.86	49.84				.020
522	15	15/32	49.30					51.20	55.00				
523	15	1/2	57.60					57.60	60.77	63.95	70.30		
524	15	17/32	69.80							71.38	77.70	84.02	
515	12	11/32	30.63			31.89	34.42	36.95					.025
3	12	21/32	58.20								62.28		
4	12	29/64	40.90					42.88	45.54	48.19			
516	12	13/32	40.60				41.95	44.65	47.35				
5	10 1/2	15/32	46.00					47.11	49.35	51.58			.028
5 1/2	10 1/2	13/32	37.26				38.37	40.59	42.82	45.04			
6	10 1/2	11/32	30.60			31.67	33.81	35.95					
7	10	1/2	38.25					38.25	40.37	42.50	46.75		.029
8	10	11/32	31.07			32.09	34.13	36.17					
511	10	19/64	23.21		23.73	25.83	27.92	30.02					
9	9	13/32	31.55				32.52	34.45	36.39				.033
10	9	5/16	24.41		24.41	26.34	28.28	30.22					
509	9	9/32	20.30		21.27	23.23	25.19						
11	8	13/32	28.08				28.94	30.66					.037
12	8	19/64	21.22		21.64	23.31	24.98	26.65					
507	8	17/64	17.27		18.54	20.22							
13	7	7/32	22.70				22.70	24.14					.042
14	7	15/64	17.88	18.25	19.71	21.17	22.64						
505	7	19/64	14.44	14.81	16.29	17.78							
15	6	9/32	19.21		19.85	21.15	22.45	23.75	25.05	26.35			.049
16	6	7/32	13.93	14.57	15.85	17.13	18.42						
23	6	9/32	40.08							40.08	42.63	45.19	
24	6	1/4	31.52					31.52	32.79	34.07	36.62		
503	6	7/32	11.93	12.58	13.89	15.20							
17	5	17/64	10.30		11.10	12.17							.059
18	5	13/64	9.28	10.06	11.12	12.17							
19	4	7/32	8.50	8.92	9.77	10.63	11.48						.074
20	4	5/32	6.25	7.47	8.29								
21	3	7/32	7.00	7.32	7.96	8.60	9.24						.098
22	3	5/32	5.37	6.28	6.90								

PENCOYD BEAMS.



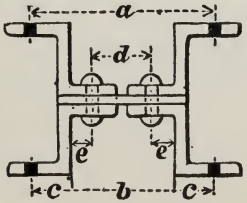
Size in Inches.	Chart Number.	Minimum. Weight in Pounds per Foot. Iron.	Minimum. Weight in Pounds per Foot. Steel.	W.	F.	C.	E.	B. In 12 Ins.	O.	R.	M.	T.
				Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
20												
18												
15	1	63.43		.56	$5\frac{21}{32}$	$1\frac{1}{4}$	$\frac{3}{4}$	$2\frac{3}{8}$	$3\frac{1}{2}$	$\frac{7}{8}$	$3\frac{1}{2}$	$11\frac{1}{16}$
15	2	49.33		.44	$5\frac{1}{8}$	$1\frac{5}{16}$	$\frac{5}{8}$	$2\frac{5}{16}$	3	$\frac{3}{4}$ to $\frac{7}{8}$	$3\frac{27}{32}$	$11\frac{19}{32}$
15	521		42.39	.41	$5\frac{5}{8}$	$\frac{25}{32}$	$\frac{7}{16}$	$1\frac{21}{32}$	$3\frac{1}{2}$	$\frac{3}{4}$	$\frac{9}{16}$	$12\frac{11}{32}$
15	522		49.30	.45	$5\frac{13}{16}$	$\frac{7}{8}$	$\frac{1}{2}$	$1\frac{37}{64}$	$3\frac{1}{2}$	$\frac{3}{4}$ to $\frac{7}{8}$	$\frac{11}{16}$	$12\frac{3}{32}$
15	523		57.60	.50	$6\frac{3}{32}$	1	$\frac{19}{32}$	$1\frac{37}{64}$	$3\frac{3}{4}$	$\frac{3}{4}$ to $\frac{7}{8}$	$\frac{25}{32}$	$11\frac{11}{16}$
15	524		69.80	.59	$6\frac{13}{32}$	$1\frac{5}{32}$	$\frac{3}{4}$	$1\frac{47}{64}$	4	$\frac{7}{8}$ to 1	$\frac{15}{16}$	$11\frac{5}{32}$
12	3	57.06	58.20	.65	$5\frac{1}{2}$	$1\frac{3}{16}$	$\frac{11}{16}$	$2\frac{13}{32}$	$3\frac{1}{2}$	$\frac{7}{8}$	$\frac{7}{8}$	$8\frac{7}{16}$
12	4	40.10	40.90	.45	$4\frac{13}{16}$	$\frac{15}{16}$	$\frac{9}{16}$	$2\frac{5}{32}$	$2\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$	$9\frac{1}{16}$
12	515	30.03	30.63	.35	5	$\frac{11}{16}$	$\frac{11}{32}$	$1\frac{11}{16}$	3	$\frac{3}{4}$ to $\frac{7}{8}$	$\frac{1}{2}$	$9\frac{13}{16}$
12	516		40.60	.40	$5\frac{1}{2}$	$\frac{7}{8}$	$\frac{1}{2}$	$1\frac{59}{64}$	$3\frac{1}{2}$	$\frac{3}{4}$ to $\frac{7}{8}$	$\frac{11}{16}$	$9\frac{19}{32}$
$10\frac{1}{2}$	5	45.10	46.00	.47	$5\frac{1}{4}$	$1\frac{1}{8}$	$\frac{21}{32}$	$2\frac{3}{8}$	$3\frac{1}{4}$	$\frac{3}{4}$ to $\frac{7}{8}$	$\frac{7}{8}$	$7\frac{13}{32}$
$10\frac{1}{2}$	$5\frac{1}{2}$	36.53	37.26	.41	$4\frac{7}{8}$	$\frac{15}{16}$	$\frac{1}{2}$	$2\frac{3}{16}$	3	$\frac{5}{8}$ to $\frac{3}{4}$	$\frac{11}{16}$	$7\frac{1}{4}$
$10\frac{1}{2}$	6	30.00	30.60	.35	$4\frac{1}{2}$	$\frac{27}{32}$	$\frac{7}{16}$	$2\frac{11}{32}$	$2\frac{1}{2}$	$\frac{3}{4}$	$\frac{5}{8}$	$8\frac{3}{32}$
10	7	37.50	38.25	.50	$4\frac{5}{8}$	1	$\frac{1}{2}$	$2\frac{29}{32}$	$2\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$	$7\frac{13}{32}$
10	8	30.46	31.07	.35	$4\frac{3}{8}$	$\frac{15}{16}$	$\frac{15}{32}$	$2\frac{13}{16}$	$2\frac{1}{2}$	$\frac{3}{4}$	$\frac{11}{16}$	$7\frac{5}{8}$
10	511		23.21	.30	$4\frac{1}{2}$	$\frac{19}{32}$	$\frac{5}{16}$	$1\frac{21}{32}$	$2\frac{1}{2}$	$\frac{5}{8}$ to $\frac{3}{4}$	$\frac{7}{16}$	$8\frac{13}{16}$
9	9	30.93	31.55	.41	$4\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{16}$	$2\frac{1}{16}$	3	$\frac{5}{8}$ to $\frac{3}{4}$	$\frac{19}{32}$	$6\frac{5}{16}$
9	10	23.93	24.41	.31	$4\frac{1}{4}$	$\frac{23}{32}$	$\frac{11}{32}$	$2\frac{3}{16}$	$2\frac{1}{2}$	$\frac{5}{8}$ to $\frac{3}{4}$	$\frac{17}{32}$	$6\frac{11}{16}$
9	509		20.30	.28	$4\frac{5}{16}$	$\frac{9}{16}$	$\frac{9}{32}$	$1\frac{11}{16}$	$2\frac{1}{2}$	$\frac{5}{8}$ to $\frac{3}{4}$	$\frac{15}{32}$	$7\frac{5}{32}$
8	11	27.53	28.08	.41	$4\frac{3}{8}$	$\frac{25}{32}$	$\frac{7}{16}$	$2\frac{1}{16}$	$2\frac{1}{2}$	$\frac{5}{8}$ to $\frac{3}{4}$	$\frac{19}{32}$	$5\frac{13}{32}$
8	12	20.80	21.22	.30	4	$\frac{11}{16}$	$\frac{5}{16}$	$2\frac{5}{16}$	$2\frac{1}{4}$	$\frac{5}{8}$ to $\frac{3}{4}$	$\frac{1}{2}$	$5\frac{1}{16}$
8	507		17.27	.26	4	$\frac{17}{32}$	$\frac{1}{4}$	$1\frac{11}{16}$	$2\frac{1}{4}$	$\frac{3}{8}$ to $\frac{5}{8}$	$\frac{3}{8}$	$6\frac{9}{32}$
7	13	22.26	22.70	.44	$3\frac{13}{16}$	$\frac{11}{16}$	$\frac{11}{32}$	$2\frac{9}{16}$	$2\frac{1}{4}$	$\frac{5}{8}$	$\frac{1}{2}$	$4\frac{13}{16}$
7	14	17.53	17.88	.24	$3\frac{5}{8}$	$\frac{11}{16}$	$\frac{11}{32}$	$2\frac{9}{16}$	2	$\frac{5}{8}$	$\frac{1}{2}$	$4\frac{13}{16}$
7	505		14.44	.24	$3\frac{3}{4}$	$\frac{15}{32}$	$\frac{1}{4}$	$1\frac{5}{8}$	$2\frac{1}{4}$	$\frac{5}{8}$	$\frac{11}{32}$	$5\frac{13}{32}$
6	23	39.30	40.08	.63	$5\frac{1}{4}$	$1\frac{1}{16}$	$\frac{5}{8}$	$2\frac{9}{32}$	$3\frac{1}{4}$	$\frac{3}{4}$ to $\frac{7}{8}$	$\frac{13}{16}$	$2\frac{5}{8}$
6	24	30.90	31.52	.50	$4\frac{7}{8}$	$\frac{7}{8}$	$\frac{1}{2}$	$2\frac{1}{16}$	3	$\frac{5}{8}$ to $\frac{3}{4}$	$\frac{21}{32}$	3
6	15	18.83	19.21	.28	$3\frac{27}{32}$	$\frac{11}{16}$	$\frac{3}{8}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$\frac{5}{8}$	$\frac{1}{2}$	$3\frac{9}{16}$
6	16	13.66	13.93	.22	$3\frac{15}{32}$	$\frac{17}{32}$	$\frac{9}{32}$	$1\frac{27}{32}$	2	$\frac{5}{8}$	$\frac{13}{32}$	$4\frac{1}{16}$
6	503		11.93	.22	$3\frac{13}{32}$	$\frac{7}{16}$	$\frac{7}{32}$	$1\frac{21}{32}$	2	$\frac{5}{8}$	$\frac{5}{16}$	$4\frac{17}{32}$
5	17	10.10	10.30	.26	$3\frac{1}{16}$	$\frac{13}{32}$	$\frac{3}{16}$	$1\frac{23}{32}$	$1\frac{3}{4}$	$\frac{3}{8}$ to $\frac{5}{8}$	$\frac{9}{32}$	$3\frac{11}{16}$
5	18		9.28	.20	3	$\frac{13}{32}$	$\frac{3}{16}$	$1\frac{23}{32}$	$1\frac{3}{4}$	$\frac{3}{8}$ to $\frac{5}{8}$	$\frac{9}{32}$	$3\frac{11}{16}$
4	19	8.33	8.50	.22	$2\frac{19}{32}$	$\frac{13}{32}$	$\frac{1}{4}$	$1\frac{13}{16}$	$1\frac{5}{8}$	$\frac{3}{8}$	$\frac{5}{16}$	$2\frac{21}{32}$
4	20	6.13	6.25	.16	$2\frac{5}{16}$	$\frac{11}{32}$	$\frac{3}{16}$	$1\frac{11}{16}$	$1\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{4}$	$2\frac{7}{8}$
3	21	6.86	7.00	.22	$2\frac{13}{32}$	$\frac{13}{32}$	$\frac{7}{32}$	2	$1\frac{3}{8}$	$\frac{3}{8}$	$\frac{5}{16}$	$1\frac{11}{16}$
3	22	5.26	5.37	.16	$2\frac{7}{32}$	$\frac{11}{32}$	$\frac{3}{16}$	2	$1\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$	$1\frac{7}{8}$



Size in Inches.	*Chart Number.*	*Minimum.* *Weight in Lbs. per Foot.* Iron.	Steel.	*W.* Ins.	*F.* Ins.	*C.* Ins.	*E.* Ins.	*B.* In 12 Ins.	*O.* Ins.	*R.* Ins.	*M.* Ins.	*T.* Ins.
15	30	47.03	48.00	9/16	3 15/16	1	5/8	1 5/16	2 3/8	7/8	1 3/16	11 5/8
15	53	35.33	36.00	3/8	3 7/8	7/8	1/2	1 9/32	2 3/8	7/8	1 21/32	11 7/8
13	55	29.47	30.10	3/8	3 7/8	3/4	3/8	1 9/32	2 3/8	7/8 or 3/4	1 7/32	10 15/16
12	31	29.70	30.30	13/32	2 15/16	1	9/16	2 1/16	1 3/4	3/4	2 5/32	8 15/16
12	54	22.37	22.80	9/32	3	19/32	9/32	1 3/8	1 3/4	3/4	7/16	9 13/16
12	427	20.90	21.30	9/32	3 3/32	5/8	3/8	1 3/16	1 7/8	3/4	1/2	9 13/16
12	32	20.07	20.50	9/32	2 5/8	3/4	11/32	2 3/32	1 1/2	3/4	1 9/32	9 7/16
10	34	20.47	20.90	21/64	2 3/4	3/4	13/32	1 5/8	1 5/8	3/4	9/16	7 1/2
10	35	16.07	16.40	1/4	2 1/2	5/8	3/8	1 1/2	1 3/8	3/4	1/2	7 13/16
9	36	17.23	17.60	5/16	2 19/32	11/16	11/32	1 13/16	1 1/2	3/4	1/2	6 3/4
9	37	12.70	13.00	15/64	2 11/32	17/32	1/4	1 5/8	1 5/16	3/4	1 3/32	7 1/4
8	418	13.50	13.80	1/4	2 1/2	19/32	5/16	1 27/32	1 3/8	3/4	1 3/32	6 1/16
8	419		11.00	7/32	2 9/32	7/16	7/32	1 1/4	1 1/4	3/4	1 11/32	6 9/16
7	40	13.70	14.00	19/64	2 9/32	11/16	5/16	2 1/4	1 3/8	5/8	1/2	5
7	417		9.00	13/64	2 1/8	13/32	3/16	1 9/32	1 1/4	5/8	9/32	5 11/16
7	41	8.23	8.40	11/64	1 15/16	7/16	1/4	1 1/4	1 1/8	5/8	11/32	5 7/16
6	42	10.73	11.00	1/4	2 1/4	9/16	9/32	1 11/16	1 1/4	5/8	7/16	4 7/32
6	44	7.70	7.90	13/64	1 3/4	7/16	1/4	1 9/16	1	1/2	11/32	4 21/32
6	415		7.50	3/16	1 15/16	3/8	3/16	1 1/8	1 1/8	1/2	9/32	4 3/4
5	412	8.23	8.40	15/64	2 1/16	7/16	1/4	1 1/4	1 1/4	5/8	5/16	3 1/2
5	413		6.10	3/16	1 13/16	11/32	3/16	1 5/32	1 1/8	1/2	1/4	3 7/8
4	47	7.20	7.30	1/4	1 23/32	17/32	1/4	2 5/16	1	1/2	3/8	2 1/2
4	48	5.50	5.60	3/16	1 17/32	13/32	1/4	1 5/16	15/16	3/8	5/16	2 23/32
4	411		5.17	11/64	1 5/8	11/32	5/32	1 5/16	15/16	3/8	1/4	2 29/32
3	49	5.10	5.20	7/32	1 17/32	13/32	1/4	1 7/16	15/16	3/8	5/16	1 3/4

STANDARD SPACING of RIVETS THROUGH FLANGES OF Z BAR COLUMNS.

Size of Z Bar.	*a.*	*b.*	*c.*	*d.*	*e.*
6 inch.	11 1/4	7 1/4	2	4 1/4	1 1/2
5 "	10	6 1/2	1 3/4	4	1 1/4
4 "	8 3/4	5 1/2	1 5/8	3	1 1/4
3 "	7 3/4	4 3/4	1 1/2	2 1/2	1 1/8



ALL RIVETS 3-4 INCH.

PENCOYD IRON CHANNELS.

Chart Number.	Depth in Inches.	Least Web Thickness.	Least Weight per Foot.	Approximate Weight in Pounds per Foot for each Thickness of Web, in Inches.									Increased Thickness in Inches for each Additional Pound per Foot.
				1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	
30	15	9/16	47.03						47.03	50.15	56.39	62.63	.020
53	15	1/2	35.33			35.33	38.45	41.58	44.70	47.83			
55	13	3/8	29.47			29.47	32.18	34.90	37.61	40.33			.023
31	12	13/32	29.70				30.95	33.45	35.95	38.45	43.45	48.45	.025
54	12	3/8	22.37		23.62	26.12	28.62	31.12	33.62				
427	12	9/32	20.90		22.15	24.65	27.15	29.65	32.15				
32	12	9/32	20.07		21.32	23.82	26.32	28.82	31.32				
33½	10½	7/16	23.63				23.63	25.82					.029
33	10½	5/16	17.57		17.57	19.76							
34	10	21/64	20.47			22.03	24.11	26.19	28.27	30.35	34.51		.030
35	10	1/4	16.07	16.07	18.15	20.23	22.31						
36	9	5/16	17.23		17.23	19.10	20.98	22.86	24.74	26.62			.033
37	9	15/64	12.70	13.17	15.04	16.92	18.80						
418	8	1/4	13.50	13.50	15.16	16.83	18.50	20.16					.038
40	7	19/64	13.70		14.06	15.52	16.98	18.43	19.89	21.35	24.27		.043
41	7	11/64	8.23	10.05	11.50	12.96	14.42						
42	6	1/4	10.73	10.73	11.98	13.23	14.48	15.73	16.98	18.25			.050
44	6	13/64	7.70	8.63	9.88	11.13							
412	5	15/64	8.23	8.49	9.53	10.57	11.61						.060
47	4	1/4	7.20	7.20	8.03	8.86	9.69	10.52					.075
48	4	5/16	5.50	6.33	7.16								
49	3	7/32	5.10	5.41	6.03								.100
50	2¼	1/4	3.77	3.77									.130
51	2	7/32	2.90	3.11	3.53								.150
52	1¾	3/32	1.13										.169

PENCOYD STEEL CHANNELS.

Chart Number.	Depth in Inches.	Least Web Thickness.	Least Weight per Foot.	Approximate Weight in Pounds per Foot for each Thickness of Web, in Inches.								Increased Thickness in Inches for each Additional Pound per Foot.
				1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	
30	15	9/16	48.00						48.00	51.18	57.56	63.93	.019
53	15	3/8	36.00			36.00	39.18	42.37	45.56	48.75			
55	13	3/8	30.10			30.10	32.86	35.62	38.38	41.14			.022
31	12	13/32	30.30				31.57	34.12	36.67	39.22	44.32	49.42	.024
54	12	3/8	22.80		24.07	26.62	29.17	31.72	34.27				
427	12	9/32	21.30		22.57	25.12	27.67	30.24	32.77				
32	12	9/32	20.50		21.77	24.32	26.87	29.42	31.97				
33½	10½	7/16	24.11				24.11	26.34					.028
33	10½	5/16	17.92		17.92	20.15							
34	10	21/64	20.90			22.49	24.61	26.74	28.86	30.99	35.24		.029
35	10	1/4	16.40	16.40	18.52	20.65	22.77						
36	9	5/16	17.60		17.60	19.51	21.42	23.33	25.24	27.15			.032
37	9	5/16	13.00	13.47	15.38	17.29	19.20						
418	8	1/4	13.80	13.80	15.50	17.20	18.90	20.60					.036
419	8	7/32	11.00	11.85	13.55	15.25							
40	7	19/64	14.00		14.37	15.85	17.34	18.83	20.32	21.80	24.78		.042
41	7	11/64	8.40	10.26	11.74	13.23	14.72						
417	7	13/64	9.00	10.11	11.59	13.08							
42	6	1/4	11.00	11.00	12.27	13.55	14.82	16.10	17.37	18.65			.049
44	6	13/64	7.90	8.85	10.12	11.40							
415	6	5/16	7.50	8.77	10.05	11.32							
412	5	15/64	8.40	8.66	9.72	10.78	11.84						.058
413	5	5/16	6.10	7.20	8.30	9.40							
47	4	1/4	7.30	7.30	8.15	9.00	9.85	10.70					.073
48	4	5/16	5.60	6.45	7.30								
411	4	11/64	5.20	6.25	7.10								
49	3	7/32	5.20	5.52	6.16								.097
50	2¼	1/4	3.84	3.84									.130
51	2	7/32	2.96	3.17									.148
52	1¾	3/32	1.15										.168

PENCOYD Z BARS.

Section Number.	Nominal Size in Inches.	Actual Size in Inches for a Variation of $\frac{1}{16}$ Inch.				Area in Square Inches.	Weight per Foot in Pounds.		Increased Thickness in Inches for each Additional Pound per Foot.	
		Flge.	Web.	Flge.	Thickness.		Iron.	Steel.	Iron.	Steel.
220	3	$2\frac{5}{8}$	3	$2\frac{5}{8}$	$\frac{1}{4}$	1.94	6.47	6.60	.038	.037
	3	$2\frac{11}{16}$	$3\frac{1}{16}$	$2\frac{11}{16}$	$\frac{5}{16}$	2.44	8.13	8.29		
	3	$2\frac{3}{4}$	$3\frac{1}{8}$	$2\frac{3}{4}$	$\frac{3}{8}$	2.94	9.80	10.00		
221	3	$2\frac{21}{32}$	3	$2\frac{21}{32}$	$\frac{7}{16}$	3.28	10.93	11.15	.040	.039
	3	$2\frac{11}{16}$	$3\frac{1}{32}$	$2\frac{11}{16}$	$\frac{5}{32}$	3.51	11.70	11.93		
	3	$2\frac{23}{32}$	$3\frac{1}{16}$	$2\frac{23}{32}$	$\frac{1}{2}$	3.75	12.50	12.75		
222	4	$2\frac{7}{8}$	4	$2\frac{7}{8}$	$\frac{1}{4}$	2.32	7.73	7.88	.032	.031
	4	$2\frac{15}{16}$	$4\frac{1}{16}$	$2\frac{15}{16}$	$\frac{5}{16}$	2.91	9.70	9.89		
	4	3	$4\frac{1}{8}$	3	$\frac{3}{8}$	3.50	11.67	11.90		
223	4	$2\frac{31}{32}$	4	$2\frac{31}{32}$	$\frac{7}{16}$	3.96	13.20	13.46	.031	.030
	4	$3\frac{1}{32}$	$4\frac{1}{16}$	$3\frac{1}{32}$	$\frac{1}{2}$	4.56	15.20	15.50		
	4	$3\frac{3}{32}$	$4\frac{1}{8}$	$3\frac{3}{32}$	$\frac{9}{16}$	5.16	17.20	17.54		
224	4	$3\frac{1}{16}$	4	$3\frac{1}{16}$	$\frac{5}{8}$	5.53	18.43	18.80	.031	.030
	4	$3\frac{3}{16}$	$4\frac{1}{8}$	$3\frac{3}{16}$	$\frac{3}{4}$	6.75	22.50	22.95		
225	5	$3\frac{3}{16}$	5	$3\frac{3}{16}$	$\frac{5}{16}$	3.36	11.20	11.42	.027	.026
	5	$3\frac{1}{4}$	$5\frac{1}{16}$	$3\frac{1}{4}$	$\frac{3}{8}$	4.05	13.50	13.77		
	5	$3\frac{5}{16}$	$5\frac{1}{8}$	$3\frac{5}{16}$	$\frac{7}{16}$	4.75	15.83	16.15		
226	5	$3\frac{7}{32}$	5	$3\frac{7}{32}$	$\frac{1}{2}$	5.23	17.43	17.78	.027	.027
	5	$3\frac{9}{32}$	$5\frac{1}{16}$	$3\frac{9}{32}$	$\frac{9}{16}$	5.91	19.70	20.09		
	5	$3\frac{11}{32}$	$5\frac{1}{8}$	$3\frac{11}{32}$	$\frac{5}{8}$	6.60	22.00	22.44		
227	5	$3\frac{1}{4}$	5	$3\frac{1}{4}$	$\frac{11}{16}$	6.96	23.20	23.66	.028	.027
	5	$3\frac{5}{16}$	$5\frac{1}{16}$	$3\frac{5}{16}$	$\frac{3}{4}$	7.64	25.46	25.97		
228	6	$3\frac{1}{2}$	6	$3\frac{1}{2}$	$\frac{3}{8}$	4.59	15.30	15.61	.023	.023
	6	$3\frac{9}{16}$	$6\frac{1}{16}$	$3\frac{9}{16}$	$\frac{7}{16}$	5.39	17.96	18.32		
	6	$3\frac{5}{8}$	$6\frac{1}{8}$	$3\frac{5}{8}$	$\frac{1}{2}$	6.19	20.63	21.05		
229	6	$3\frac{1}{2}$	6	$3\frac{1}{2}$	$\frac{9}{16}$	6.68	22.27	22.71	.024	.023
	6	$3\frac{9}{16}$	$6\frac{1}{16}$	$3\frac{9}{16}$	$\frac{5}{8}$	7.46	24.87	25.36		
	6	$3\frac{5}{8}$	$6\frac{1}{8}$	$3\frac{5}{8}$	$\frac{11}{16}$	8.25	27.50	28.05		
230	6	$3\frac{1}{2}$	6	$3\frac{1}{2}$	$\frac{3}{4}$	8.64	28.80	29.37	.025	.025
	6	$3\frac{9}{16}$	$6\frac{1}{16}$	$3\frac{9}{16}$	$\frac{13}{16}$	9.38	31.27	31.89		
	6	$3\frac{5}{8}$	$6\frac{1}{8}$	$3\frac{5}{8}$	$\frac{7}{8}$	10.16	33.86	34.54		

For rivet spacing, see page 5.

PENCOYD IRON DECK BEAMS.

Section Number.	Depth in Inches.	Minim. Flange Width in Inches.	Minimum Web Thickness in Ins.	Minim. Weight per Ft. in Lbs.	Approximate Weight in Pounds per Foot for each Thickness of Web, in Inches.								Increased Thickness in Ins. for each Additional Pound per Foot.
					5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	
69	11½	5 1/32	1/2	35.1				35.1	37.5	39.9	42.3	44.7	.027
62	10	5¼	29/64	27.6		27.6	29.6	31.7	33.8	35.9	38.0		.030
63	9	5	29/64	24.2		24.2	26.1	27.9	29.8	31.7			.033
64	8	4 5/8	11/32	20.6		21.4	23.0	24.7	26.4	28.1			.037
65	7	4¼	11/32	17.5		18.2	19.7	21.2	22.6	24.1			.042
66	6	3 3/4	5/16	14.1	14.1	15.3	16.6	17.8	19.1				.050
67	5	3¼	5/16	11.3	11.3	12.3	13.4	14.4	15.5				.060

STEEL DECK BEAMS.

69	11½	5 1/32	1/2	35.8				35.8	38.2	40.7	43.1	45.6	.026
62	10	5¼	29/64	28.1		28.1	30.3	32.4	34.5	36.6	38.7		.029
63	9	5	29/64	24.7		24.7	26.6	28.5	30.4	32.3			.033
64	8	4 5/8	11/32	21.0		21.8	23.5	25.2	26.9	28.6			.036
65	7	4¼	11/32	17.9		18.6	20.1	21.6	23.1	24.6			.041
66	6	3¾	5/16	14.4	14.4	15.6	16.9	18.2	19.5				.049
67	5	3¼	5/16	11.5	11.5	12.5	13.6	14.7	15.8				.058

IRON BULB PLATES.

68	10		1/2	20.7				20.7	22.8	24.9			.030

STEEL BULB PLATES.

68	10		1/2	21.1				21.1	23.3	25.4			.029

IRON BULB ANGLES.

250	10	3 5/8	1/2	25.1				25.1	27.9	30.7			.030
251	9	3½	31/64	22.0				22.5	24.3				.033
252	8	3⅜	29/64	19.1				20.9	23.3				.037
253	7	3 3/16	13/32	15.6			16.7	18.8	17.0				.042
254	6	3	23/64	12.4		13.0	14.2	15.4	16.5				.049
255	5	2¾	5/16	9.4	9.4	10.4	11.4						.063

STEEL BULB ANGLES.

250	10	3 5/8	1/2	25 6				25.5	28.4	31.3			.029
251	9	3½	31/64	22.4				22.9	24.7				.032
252	8	3⅜	29/64	19.5				21.3	23.7				.036
253	7	3 3/16	13/32	15.9			17.0	19.1					.041
254	6	3	23/64	12.6		13.26	14.5	15.7	16.8				.048
255	5	2¾	5/16	9.6	9.6	10.6	11.6						.062

PENCOYD IRON ANGLES.

EVEN LEGS.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
		.125	.1875	.25	.3125	.375	.4375	.50	.5625	.625	.6875	.75	.875	1.00
120	6 x 6					14.5	17.0	19.5	21.9	24.4	26.0	28.5	33.5	38.5
121	5 x 5					12.0	14.0	16.1	18.2	20.3	22.4	24.5	28.6	32.8
122	4 x 4				8.0	9.6	11.1	12.7	14.3	15.8	17.4	19.0		
123	3½ x 3½				7.0	8.4	9.8	11.2	12.6	14.0				
124	3 x 3			4.8	5.9	7.0	8.1	9.2	10.3	11.4				
125	2¾ x 2¾			4.4	5.5	6.6	7.7	8.8						
126	2½ x 2½		3.0	4.0	5.0	6.0	7.0	8.0						
127	2¼ x 2¼		2.6	3.5	4.4	5.3								
128	2 x 2		2.4	3.2	4.0	4.8								
129	1¾ x 1¾		2.1	2.8	3.5	4.3								
130	1½ x 1½	1.13	1.77	2.3	2.9	3.5								
131	1¼ x 1¼	1.00	1.50	2.00										
132	1 x 1	0.80	1.13	1.50										

UNEVEN LEGS.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
		.125	.1875	.25	.3125	.375	.4375	.50	.5625	.625	.6857	.75	.875	1.00
154	7 x 3½							16.7	18.6	20.5	22.4	24.3	28.1	31.9
152	6½ x 4					12.6	14.7	16.8	18.9	21.0	23.1	25.2	29.4	33.6
140	6 x 4					12.0	14.1	16.1	18.2	20.3	22.3	24.4	28.5	32.7
151	6 x 3½					11.3	13.3	15.3	17.3	19.3	21.3	23.3	27.3	31.3
153	5½ x 3½					10.8	12.5	14.3	16.1	17.8				
141	5 x 4					10.8	12.5	14.3	16.1	17.8	19.6	21.4		
142	5 x 3½				8.5	10.1	11.7	13.3	14.9	16.5	18.1	19.7		
143	5 x 3				8.0	9.5	11.0	12.5	14.0	15.5	17.0	18.5		
144	4½ x 3				7.6	9.0	10.4	11.9	13.3	14.7	16.2	17.6		
145	4 x 3½				7.6	9.0	10.4	11.9	13.3	14.7	16.2	17.6		
146	4 x 3				7.0	8.4	9.8	11.2	12.6	14.0				
147	3½ x 3				6.4	7.7	9.0	10.3	11.6	12.9				
150	3½ x 2½			4.8	5.9	7.0	8.1	9.2						
159	3½ x 2			4.4	5.5	6.6								
148	3 x 2½			4.4	5.5	6.6	7.7	8.8						
149	3 x 2			4.0	5.0	6.0	7.0	8.0						
155	2½ x 2		2.6	3.5	4.4	5.3	6.2	7.1						
156	2¼ x 1½		2.23	3.0	3.7	4.5								
157	2 x 1¼		1.90	2.6	3.2	3.9								

PENCOYD STEEL ANGLES.

EVEN LEGS.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8 .125	3/16 .1875	1/4 .25	5/16 .3125	3/8 .375	7/16 .4375	1/2 .50	9/16 .5625	5/8 .625	11/16 .6875	3/4 .75	7/8 .875	1 1.00
120	6 x 6					14.8	17.3	19.9	22.3	24.9	26.5	29.1	34.2	39.3
121	5 x 5					12.2	14.3	16.4	18.5	20.7	22.8	25.0	29.2	33.4
122	4 x 4				8.2	9.8	11.3	13.0	14.6	16.1	17.7	19.3		
123	3½ x 3½				7.1	8.6	10.0	11.4	12.8	14.2				
124	3 x 3			4.9	6.0	7.1	8.3	9.4	10.5	11.6				
125	2¾ x 2¾			4.5	5.6	6.7	7.8	8.9						
126	2½ x 2½		3.1	4.1	5.1	6.1	7.1							
127	2¼ x 2¼		2.7	3.6	4.5	5.4								
128	2 x 2		2.44	3.3	4.1	4.9								
129	1¾ x 1¾		2.14	2.9	3.6	4.4								
130	1½ x 1½	1.16	1.80	2.4	3.0	3.6								
131	1¼ x 1¼	1.02	1.53	2.04										
132	1 x 1	0.82	1.16	1.53										

UNEVEN LEGS.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8 .125	3/16 .1875	1/4 .25	5/16 .3125	3/8 .375	7/16 .4375	1/2 .50	9/16 .5625	5/8 .625	11/16 .6875	3/4 .75	7/8 .875	1 1.00
154	7 x 3½							17.0	18.9	20.9	22.8	24.8	28.6	32.5
152	6½ x 4					12.9	15.0	17.1	19.3	21.4	23.6	25.7	30.0	34.3
140	6 x 4					12.2	14.4	16.4	18.6	20.7	22.8	24.9	29.1	33.3
151	6 x 3½					11.5	13.6	15.6	17.6	19.7	21.7	23.8	27.8	31.9
153	5½ x 3½					11.0	12.8	14.6	16.4	18.2				
141	5 x 4					11.0	12.8	14.6	16.4	18.2	20.0	21.8		
142	5 x 3½				8.7	10.3	12.0	13.6	15.2	16.8	18.5	20.1		
143	5 x 3				8.2	9.7	11.2	12.8	14.3	15.8	17.3	18.9		
144	4½ x 3				7.7	9.2	10.6	12.1	13.6	15.0	16.5	18.0		
145	4 x 3½				7.7	9.2	10.6	12.1	13.6	15.0	16.5	18.0		
146	4 x 3				7.1	8.6	10.0	11.4	12.8	14.2				
147	3½ x 3				6.6	7.9	9.2	10.5	11.8	13.1				
150	3½ x 2½			4.9	6.0	7.1	8.3	9.4						
159	3½ x 2			4.5	5.6	6.7								
148	3 x 2½			4.5	5.6	6.7	7.8	8.9						
149	3 x 2			4.1	5.1	6.1	7.1	8.2						
155	2½ x 2		2.7	3.6	4.5	5.4	6.3	7.2						
156	2¼ x 1½		2.24	3.03	3.8	4.6								
157	2 x 1¼		1.94	2.7	3.3	4.0								

PENCOYD IRON ANGLES.

SQUARE ROOT ANGLES.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
		.125	.1875	.25	.3125	.375	.4375	.50	.5625	.625	.6875	.75	.875	1.00
160	4 x 4					9.6	11.1	12.7	14.3	15.8				
161	3½ x 3½				7.0	8.4	9.8	11.2						
162	3 x 3			4.8	5.9	7.0	8.1	9.2						
163	2¾ x 2¾			4.4	5.5	6.6	7.7	8.8						
164	2½ x 2½			4.0	5.0	6.0	7.0	8.0						
165	2¼ x 2¼			3.5	4.4	5.3								
166	2 x 2			3.2	4.0	4.8								
167	1¾ x 1¾			2.8	3.5	4.3								
168	1½ x 1½		1.77	2.3	2.9									
169	1¼ x 1¼		1.50	2.00	2.50									
170	1 x 1	0.80	1.13	1.50										

ANGLE COVERS.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
		.125	.1875	.25	.3125	.375	.4375	.50	.5625	.625	.6875	.75	.875	1.00
180	3 x 3			4.7	5.8	6.9	8.0	9.1	10.2	11.3				
181	2¾ x 2¾			4.3	5.4	6.5	7.6	8.7						
182	2½ x 2½		2.9	3.9	4.9	5.9	6.9	7.9						
183	2¼ x 2¼		2.5	3.4	4.3	5.2								
184	2 x 2		2.3	3.1	3.9	4.7								

SPECIAL ANGLES.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
		.125	.1875	.25	.3125	.375	.4375	.50	.5625	.625	.6875	.75	.875	1.00
158	2⅝ x 2¼			4.1	5.2	6.3								
214	4½ x 1½		3.5	4.8										
199	4½ x 1							8.4						
211	2¾ x 2½			2.6										
172	2⅝ x 1⅜							6.2						

PENCOYD STEEL ANGLES.

SQUARE ROOT ANGLES.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
		.125	.1875	.25	.3125	.375	.4375	.50	.5625	.625	.6875	.75	.875	1.00
160	4 x 4					9.8	11.4	13.0	14.6	16.2				
161	3½ x 3½				7.1	8.5	9.9	11.4						
162	3 x 3			4.9	6.1	7.2	8.3	9.4						
163	2¾ x 2¾			4.5	5.6	6.7	7.8	8.9						
164	2½ x 2½			4.1	5.1	6.1	7.1	8.2						
165	2¼ x 2¼			3.6	4.5	5.4								
166	2 x 2			3.3	4.1	4.9								
167	1¾ x 1¾			2.9	3.6	4.4								
168	1½ x 1½		1.80	2.4	3.0									
169	1¼ x 1¼		1.53	2.04	2.55									
170	1 x 1	0.82	1.16	1.53										

ANGLE COVERS.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
		.125	.1875	.25	.3125	.375	.4375	.50	.5625	.625	.6875	.75	.875	1.00
180	3 x 3			4.8	5.9	7.1	8.2	9.3	10.4	11.5				
181	2¾ x 2¾			4.4	5.5	6.6	7.7	8.8						
182	2½ x 2½		3.0	4.0	5.0	6.0	7.0	8.1						
183	2¼ x 2¼		2.6	3.5	4.4	5.3								
184	2 x 2		2.4	3.2	4.0	4.8								

SPECIAL ANGLES.

No. of Section.	Size in Inches.	Approximate Weight in Pounds per Foot for Various Thicknesses in Inches.												
		1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1
		.125	.1875	.25	.3125	.375	.4375	.50	.5625	.625	.6875	.75	.875	1.00
158	2⅞ x 2¼			4.2	5.3	6.4								
214	4½ x 1½		3.6	4.9										
199	4½ x 1							8.6						
211	2¾ x 2½			2.7										
172	2⅝ x 1⅜							6.3						

PENCOYD TEES.

EVEN TEES. **UNEVEN TEES.**

For details, see lithographs—Plates Nos. 27, 28, 29.

Chart Number.	*Size in Inches.*	*Weight per Foot.*		*Chart Number.*	*Size in Inches.*	*Weight per Foot.*	
		Iron.	*Steel.*			*Iron.*	*Steel.*
70	4 x 4	12.40	12.65	107	5 x 4	14.70	15.00
71	$3\frac{1}{2}$ x $3\frac{1}{2}$	10.17	10.37	106	5 x $3\frac{1}{2}$	16.13	16.46
72	3 x 3	8.33	8.50	93	5 x $2\frac{9}{16}$	11.03	11.25
82	3 x 3	6.43	6.56	92	5 x $2\frac{1}{2}$	10.23	10.44
83	3 x 3	7.53	7.68	90	$4\frac{1}{2}$ x $3\frac{1}{2}$	14.83	15.13
84	$2\frac{1}{2}$ x $2\frac{1}{2}$	4.83	4.93	109	4 x $4\frac{1}{2}$	13.23	13.50
73	$2\frac{1}{2}$ x $2\frac{1}{2}$	6.50	6.63	91	4 x $3\frac{1}{2}$	13.93	14.21
74	$2\frac{1}{2}$ x $2\frac{1}{2}$	5.73	5.85	94	4 x 3	8.63	8.81
75	$2\frac{1}{4}$ x $2\frac{1}{4}$	3.90	3.98	95	4 x 3	8.37	8.53
76	$2\frac{1}{4}$ x $2\frac{1}{4}$	3.93	4.01	96	4 x 2	6.43	6.56
77	2 x 2	3.47	3.54	97	3 x $3\frac{1}{2}$	9.37	9.55
78	$1\frac{3}{4}$ x $1\frac{3}{4}$	2.37	2.41	98	3 x $2\frac{1}{2}$	7.93	8.09
79	$1\frac{1}{2}$ x $1\frac{1}{2}$	2.00	2.04	110	3 x $2\frac{1}{2}$	5.87	5.98
80	$1\frac{1}{4}$ x $1\frac{1}{4}$	1.50	1.53	111	3 x $2\frac{1}{2}$	6.87	7.00
81	1 x 1	1.03	1.05	117	3 x $2\frac{1}{2}$	5.00	5.10
85	4 x 4	10.98	11.19	99	3 x $1\frac{1}{2}$	3.73	3.81
				105	$2\frac{3}{4}$ x 2	7.13	7.28
				104	$2\frac{3}{4}$ x $1\frac{3}{4}$	6.53	6.66
				100	$2\frac{1}{2}$ x $1\frac{1}{4}$	3.03	3.09
				108	$2\frac{1}{4}$ x $0\frac{9}{16}$	2.20	2.24
				101	2 x $1\frac{1}{2}$	2.90	2.96
				112	2 x $1\frac{1}{16}$	2.07	2.11
				102	2 x 1	2.33	2.38
				103	2 x $\frac{9}{16}$	2.03	2.07
				116	$1\frac{3}{4}$ x $1\frac{1}{4}$	3.47	3.54
				113	$1\frac{3}{4}$ x $1\frac{1}{16}$	1.87	1.90
				114	$1\frac{1}{2}$ x $\frac{15}{16}$	1.37	1.39
				115	$1\frac{1}{4}$ x $\frac{15}{16}$	1.13	1.16
				118	3 x $2\frac{1}{2}$	5.92	6.03
				119	$2\frac{3}{4}$ x $2\frac{1}{2}$	5.63	5.74

IRON CAR BUILDERS' CHANNELS.

Section Number.	Depth in Inches.	Minimum Flange Width in Inches.	Minimum Web Thickness in Inches.	Minimum Weight per Foot in Pounds.	Approximate Weight in Pounds per Foot for each Thickness of Web, in Inches.						Increased Thickness in Inches for each Additional Pound per Foot.
					5/16	3/8	7/16	1/2	9/16	5/8	
55	13	3 7/8	3/8	29.5		29.5	32.2	34.9	37.6	40.3	.023
54	12	3	9/32	22.4	23.6	26.1	28.6	31.1	33.6		.025
33 1/2	10 1/2	3 3/8	7/16	23.6			23.6	25.8			.029
33	10 1/2	2 1/2	5/16	17.6	17.6	19.8					.029

STEEL CAR BUILDERS' CHANNELS.

55	13	3 7/8	3/8	30.1		30.1	32.9	35.6	38.4	41.1	.022
54	12	3	9/32	22.8	24.1	26.6	29.2	31.7	34.3		.024
33 1/2	10 1/2	3 3/8	7/16	24.1			24.1	26.3			.028
33	10 1/2	2 1/2	5/16	17.9	17.9	20.2					.028

MISCELLANEOUS SHAPES.

Section Numbers.	Section.	Sizes in Inches.	Weight per Foot in Pounds.	
			Iron.	Steel.
196	Grooved Bars.	2 1/2 x 3/8 x 5/8	2.8 to 4.9	2.9 to 5.0
197		3 x 1/2 x 3/4	4.5 to 7.0	4.6 to 7.1
198		3 19/32 x 5/8 x 1	7.0 to 11.5	7.1 to 11.7
204		3 1/2 x 3/8 x 5/8	4.2 to 7.1	4.3 to 7.2
205		4 3/4 x 9/16	8.5	8.7
194	Half Ovals.	1 1/4 x 1/2	1.6	1.6
193		1 1/8 x 1/2	1.4	1.4
190	Miner's Track Rail.		8.3	8.5
191	Splice Bar.		1.7	1.7
192	Slot Rails.		8.7	8.9
203			13.7	14.0
206			13.3	13.6
201	Splice Bars.		10.0	10.2
207			8.3	8.5
216			8.9	9.1
200	Bridge Rail.		11.7 to 13.3	11.9 to 13.6
195	Channel Rail.	1 3/4 x 5/8	1.2 to 1.4	1.2 to 1.4
208	Clamp.		6.3	6.4
172	Half Tee.	2 5/8 x 1 3/8 x 1/2	6.2	6.3
213	Slot Rail Guard.	2 3/4 x 2 1/4 x 3/8 x 5/8	8.7	8.9
212	Spoke Bar.	5 x 5/8 to 3/4	8.0 to 10.3	8.2 to 10.5
215	Flitch Plate	15 1/2 x 3/8 to 1/2	33.4 to 39.9	34.1 to 39.9
217	Heavy Rail.	6"	48.9	49.9
209	Floor Bars.	4 3/8 x 5 x 4 3/8 x 1/2 to 3/4	15.9 to 23.7	
210		3 1/16 x 4 x 3 1/16 x 1/4 to 1/2	7.0 to 14.0	7.1 to 14.3
260		2 1/2 x 6 1/2 x 2 1/2 x 1/4 to 3/8	9.6 to 14.4	9.8 to 14.7
218	Sash Bar.	1 3/4 x 1 7/8 x 15/64 x 7/64	2.25	2.3

SIZES OF PENCOYD BARS.

IRON OR STEEL.

FLATS.

7/8	x	3/8	inches to	3/4	inches.		2 1/2	x	1/4	inches to	1 3/4	inches.
1	x	1/4	"	7/8	"		2 3/4	x	1/4	"	2 1/2	"
1 1/32	x	1/2	"	1	"		2 15/16	x	1 7/16	"	2 5/8	"
1 1/16	x	1/2	"	1	"		3	x	1/4	"	2 3/4	"
1 1/8	x	1/4	"	1	"		3 1/8	x	1 7/16	"	3	"
1 3/16	x	5/8	"	1	"		3 1/4	x	1/4	"	2 3/4	"
1 7/32	x	1/2	"	1	"		3 1/2	x	1/4	"	2 3/4	"
1 1/4	x	1/4	"	1	"		3 3/4	x	5/8	"	2 1/2	"
1 5/16	x	5/8	"	1	"		4	x	1/4	"	3 1/2	"
1 3/8	x	1/4	"	1 1/4	"		4 1/4	x	1 1/2	"	3 3/4	"
1 13/32	x	5/8	"	1	"		4 1/2	x	1/4	"	3	"
1 7/16	x	11/16	"	1 1/8	"		4 3/4	x	1/2	"	2 1/2	"
1 1/2	x	1/4	"	1 1/4	"		5	x	1/4	"	3 1/2	"
1 19/32	x	3/4	"	1 1/4	"		5 1/4	x	3/4	"	2 1/2	"
1 5/8	x	1/4	"	1 1/2	"		5 1/2	x	1/2	"	2 1/2	"
1 3/4	x	1/4	"	1 1/4	"		6	x	1/4	"	3	"
1 31/32	x	5/8	"	1 3/4	"		6 1/2	x	3/4	"	2	"
2	x	1/4	"	1 1/2	"		7	x	1/4	"	3	"
2 5/32	x	1 3/8	"	2	"		8	x	1/4	"	2 1/2	"
2 1/4	x	1/4	"	1 7/8	"		9	x	1/4	"	2 3/4	"
2 5/16	x	1 1/2	"	2	"		10	x	1/4	"	2 1/2	"
2 3/8	x	5/8	"	1 3/4	"		12	x	1/4	"	2	"

ROUNDS.

1/2, 9/16, 5/8, 11/16, 3/4, 13/16, 7/8, 15/16, 1, 1 1/16, 1 1/8, 1 3/16, 1 1/4, 1 5/16, 1 3/8, 1 7/16, 1 1/2, 1 9/16, 1 5/8, 1 3/4, 1 7/8, 2, 2 1/8, 2 1/4, 2 3/8, 2 1/2, 2 5/8, 2 3/4, 2 7/8, 3, 3 1/8, 3 1/4, 3 3/8, 3 1/2, 3 5/8, 3 3/4, 3 7/8, 4, 4 1/8, 4 1/4, 4 3/8, 4 1/2, 4 5/8, 4 3/4, 4 7/8, 5, 5 1/4, 5 1/2, 5 3/4, 6, 6 1/2, 7 inches.

HALF ROUNDS.

1/2, 9/16, 5/8, 11/16, 3/4, 13/16, 7/8, 15/16, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 5/8, 1 3/4, 2, 2 1/4, 2 1/2, 3, 3 1/2, 4 inches.

SQUARES.

1/2, 9/16, 5/8, 11/16, 3/4, 13/16, 7/8, 15/16, 1, 1 1/16, 1 1/8, 1 3/16, 1 1/4, 1 3/8, 1 1/2, 1 5/8, 1 3/4, 1 7/8 2, 2 1/8, 2 1/4, 2 3/8, 2 1/2, 2 5/8, 2 3/4, 2 7/8, 3, 3 1/8, 3 1/4, 3 3/8, 3 1/2, 3 5/8, 3 3/4, 3 7/8, 4, 4 1/8, 4 1/4, 4 3/8, 4 1/2, 4 5/8, 4 3/4, 4 7/8, 5 inches.

RIVET SIZES.

30/64, 31/64, 33/64, 37/64, 38/64, 39/64, 41/64, 46/64, 47/64, 49/64, 53/64, 54/64, 55/64, 57/64, 61/64, 62/64, 63/64, 1 1/64, 1 5/64, 1 9/64, 1 13/64, 1 17/64 inches.

BOLT SIZES 1/64TH FULL.

1/2, 9/16, 5/8, 11/16, 3/4, 13/16, 7/8, 15/16, 1, 1 1/16, 1 1/8, 1 3/16, 1 1/4 inches.

BAR IRON EXTRAS.

EASTERN CLASSIFICATION.

BASE SIZES.

Rounds and Squares, $\frac{3}{4}$ to 2 in. | Flat Iron, 1 to 4 in. x $\frac{3}{8}$ to $1\frac{1}{2}$

Flat Iron, . . . $4\frac{1}{8}$ to 6 in. x $\frac{3}{8}$ to 1 in.

EXTRA SIZES.

Round and Square Iron.

	Extra per lb.
$\frac{3}{8}$ in.,	.5 ct.
$\frac{7}{16}$ "	.4 "
$\frac{1}{2}$ and $\frac{9}{16}$ in.,	.2 "
$\frac{5}{8}$ " $\frac{11}{16}$ "	.1 "
$2\frac{1}{8}$ to $2\frac{7}{8}$ "	.1 "
3 " $3\frac{1}{2}$ "	.3 "
$3\frac{5}{8}$ " 4 "	.5 "
$4\frac{1}{8}$ " $4\frac{1}{2}$ "	.6 "
$4\frac{5}{8}$ " 5 "	.8 "
$5\frac{1}{8}$ " $5\frac{1}{2}$ "	1.0 "
$5\frac{5}{8}$ " 6 "	1.5 "
$6\frac{1}{4}$ " $6\frac{1}{2}$ "	2.0 "
$6\frac{3}{4}$ " 7 "	2.5 "

Centering and Straightening, ...1 ct.

Flat Iron.

	Extra per lb.
$\frac{7}{8}$ x $\frac{3}{8}$ in. to $\frac{3}{4}$ in.,	.4 ct.
1 x $\frac{3}{16}$ "	.4 "
1 to 6 in. x $\frac{1}{4}$ and $\frac{5}{16}$,	.2 "
2 " 4 " x $1\frac{5}{8}$ to 2 in.,	.2 "
2 " 4 " x $2\frac{1}{8}$ " 3 "	.3 "
$4\frac{1}{8}$ " 6 " x $1\frac{1}{8}$ " 2 "	.2 "
$4\frac{1}{8}$ " 6 " x $2\frac{1}{8}$ " 3 "	.4 "
7 x $\frac{3}{8}$ " to 1 in.,	.3 "
7 x $1\frac{1}{8}$ " " 2 "	.4 "
8 x $\frac{3}{8}$ " " 1 "	.4 "
8 x $1\frac{1}{8}$ " " 2 "	.6 "
9 x $\frac{3}{8}$ " " 1 "	.6 "
9 x $1\frac{1}{8}$ " " 2 "	.8 "
10 x $\frac{3}{8}$ " " 1 "	.8 "
10 x $1\frac{1}{8}$ " " 2 "	1.0 "
11 x $\frac{3}{8}$ " " 1 "	.9 "
11 x $1\frac{1}{8}$ " " 2 "	1.1 "
12 x $\frac{3}{8}$ " " 1 "	.9 "
12 x $1\frac{1}{8}$ " " 2 "	1.1 "

6 to 12 x $\frac{1}{4}$ to $\frac{5}{16}$ thick, .2 ct. extra above $\frac{3}{8}$ths.

Cutting Ordinary Bars to Specified Lengths.

	Extra per lb.
Flat bars, 10 to 30 ft. long	.2 ct.
Over 30 ft. long, .1 ct. for every 10 ft. or fraction thereof.	
Round and square bars to 4 in. diameter, and from 10 to 20 ft. long,	.2 "
Over 4 in. diameter,	.3 "

PENCOYD ANGLES.

IRON AND STEEL.

Size, area and weight per foot of various thicknesses in pounds.
Actual lengths of legs corresponding to given thicknesses.

Size.	Area.	Weight per Foot.	
		Iron.	Steel.
6 x 6 x 3/8	4.36	14.53	14.82
6 1/16 x 6 1/16 x 7/16	5.10	17.00	17.34
6 1/8 x 6 1/8 x 1/2	5.84	19.47	19.86
6 3/16 x 6 3/16 x 9/16	6.58	21.93	22.37
6 1/4 x 6 1/4 x 5/8	7.32	24.40	24.89
6 x 6 x 11/16	7.80	26.00	26.52
6 1/16 x 6 1/16 x 3/4	8.55	28.50	29.07
6 1/8 x 6 1/8 x 13/16	9.30	31.00	31.62
6 3/16 x 6 3/16 x 7/8	10.05	33.50	34.17
6 1/4 x 6 1/4 x 15/16	10.80	36.00	36.72
6 5/16 x 6 5/16 x 1	11.55	38.50	39.27
5 x 5 x 3/8	3.60	12.00	12.24
5 1/16 x 5 1/16 x 7/16	4.21	14.03	14.31
5 1/8 x 5 1/8 x 1/2	4.82	16.07	16.39
5 3/16 x 5 3/16 x 9/16	5.45	18.17	18.53
5 1/4 x 5 1/4 x 5/8	6.09	20.30	20.71
5 5/16 x 5 5/16 x 11/16	6.72	22.40	22.85
5 3/8 x 5 3/8 x 3/4	7.36	24.53	25.02
5 7/16 x 5 7/16 x 13/16	7.97	26.57	27.10
5 1/2 x 5 1/2 x 7/8	8.58	28.60	29.17
5 9/16 x 5 9/16 x 15/16	9.20	30.67	31.28
5 5/8 x 5 5/8 x 1	9.83	32.77	33.43
4 x 4 x 5/16	2.40	8.00	8.16
4 1/16 x 4 1/16 x 3/8	2.87	9.57	9.76
4 1/8 x 4 1/8 x 7/16	3.34	11.13	11.36
4 3/16 x 4 3/16 x 1/2	3.81	12.70	12.95
4 1/4 x 4 1/4 x 9/16	4.28	14.27	14.55
4 5/16 x 4 5/16 x 5/8	4.75	15.83	16.15
4 3/8 x 4 3/8 x 11/16	5.22	17.40	17.75
4 7/16 x 4 7/16 x 3/4	5.69	18.97	19.35
3 1/2 x 3 1/2 x 5/16	2.09	6.97	7.11
3 9/16 x 3 9/16 x 3/8	2.51	8.37	8.53
3 5/8 x 3 5/8 x 7/16	2.93	9.77	9.96
3 11/16 x 3 11/16 x 1/2	3.35	11.17	11.39
3 3/4 x 3 3/4 x 9/16	3.77	12.57	12.82
3 13/16 x 3 13/16 x 5/8	4.19	13.97	14.24
3 x 3 x 1/4	1.45	4.83	4.93
3 1/16 x 3 1/16 x 5/16	1.78	5.93	6.05
3 1/8 x 3 1/8 x 3/8	2.11	7.03	7.17
3 3/16 x 3 3/16 x 7/16	2.44	8.13	8.30
3 1/4 x 3 1/4 x 1/2	2.77	9.23	9.42
3 5/16 x 3 5/16 x 9/16	3.10	10.33	10.54
3 3/8 x 3 3/8 x 5/8	3.43	11.43	11.66
2 3/4 x 2 3/4 x 1/4	1.31	4.37	4.45
2 13/16 x 2 13/16 x 5/16	1.64	5.47	5.58
2 7/8 x 2 7/8 x 3/8	1.97	6.57	6.70
2 15/16 x 2 15/16 x 7/16	2.30	7.67	7.82
3 x 3 x 1/2	2.63	8.77	8.94
2 1/2 x 2 1/2 x 3/16	0.90	3.00	3.06
2 9/16 x 2 9/16 x 1/4	1.20	4.00	4.08
2 5/8 x 2 5/8 x 5/16	1.50	5.00	5.10
2 11/16 x 2 11/16 x 3/8	1.80	6.00	6.12
2 3/4 x 2 3/4 x 7/16	2.10	7.00	7.14
2 13/16 x 2 13/16 x 1/2	2.40	8.00	8.16
2 1/4 x 2 1/4 x 3/16	0.79	2.63	2.69
2 5/16 x 2 5/16 x 1/4	1.05	3.50	3.57
2 3/8 x 2 3/8 x 5/16	1.31	4.37	4.46
2 7/16 x 2 7/16 x 3/8	1.59	5.30	5.41
2 x 2 x 3/16	0.72	2.40	2.45
2 1/16 x 2 1/16 x 1/4	0.95	3.17	3.23
2 1/8 x 2 1/8 x 5/16	1.19	3.97	4.05
2 3/16 x 2 3/16 x 3/8	1.45	4.83	4.93
1 3/4 x 1 3/4 x 3/16	0.63	2.10	2.14
1 13/16 x 1 13/16 x 1/4	0.83	2.77	2.82
1 7/8 x 1 7/8 x 5/16	1.05	3.50	3.57
1 15/16 x 1 15/16 x 3/8	1.29	4.30	4.39
1 1/2 x 1 1/2 x 1/8	0.34	1.13	1.16
1 9/16 x 1 9/16 x 3/16	0.53	1.77	1.80
1 5/8 x 1 5/8 x 1/4	0.70	2.33	2.38
1 11/16 x 1 11/16 x 5/16	0.88	2.93	2.99
1 3/4 x 1 3/4 x 3/8	1.05	3.50	3.57
1 1/4 x 1 1/4 x 1/4	0.30	1.00	1.02
1 5/16 x 1 5/16 x 3/16	0.45	1.50	1.53
1 3/8 x 1 3/8 x 1/4	0.59	1.97	2.01
1 x 1 x 1/8	0.23	0.77	0.78
1 1/16 x 1 1/16 x 3/16	0.34	1.13	1.16
1 1/8 x 1 1/8 x 1/4	0.45	1.50	1.53

PENCOYD ANGLES.

IRON AND STEEL.

Size, area and weight per foot of various thicknesses in pounds.
Actual lengths of legs corresponding to given thicknesses.

Size.	Area.	Weight per Foot.	
		Iron.	Steel.
7 x 3½ x 1/2	5.00	16.67	17.00
7 1/16 x 3 9/16 x 9/16	5.57	18.57	18.94
7⅛ x 3⅜ x ⅝	6.14	20.47	20.88
7 3/16 x 3 11/16 x 11/16	6.71	22.37	22.81
7 x 3½ x ¾	7.28	24.27	24.75
7 1/16 x 3 9/16 x 13/16	7.85	26.17	26.69
7⅛ x 3⅜ x ⅞	8.42	28.07	28.63
7 3/16 x 3 11/16 x 15/16	8.99	29.97	30.57
7¼ x 3¾ x 1	9.56	31.87	32.50
6½ x 4 x 3/2	3.78	12.60	12.85
6 9/16 x 4 1/16 x 7/16	4.41	14.70	14.99
6⅝ x 4⅛ x ½	5.04	16.80	17.14
6 11/16 x 4 3/16 x 9/16	5.67	18.90	19.28
6¾ x 4¼ x ⅝	6.30	21.00	21.42
6 13/16 x 4 5/16 x 11/16	6.93	23.10	23.56
6⅞ x 4⅜ x ¾	7.56	25.20	25.70
6 15/16 x 4 7/16 x 13/16	8.19	27.30	27.85
7 x 4½ x ⅞	8.82	29.40	29.99
7 1/16 x 4 9/16 x 15/16	9.45	31.50	32.13
7⅛ x 4⅝ x 1	10.08	33.60	34.27
6 x 4 x 3/8	3.60	12.00	12.24
6 1/16 x 4 1/16 x 7/16	4.22	14.07	14.35
6¼ x 4¼ x ½	4.84	16.13	16.46
6 3/16 x 4 3/16 x 9/16	5.46	18.20	18.56
6¼ x 4¼ x ⅝	6.08	20.27	20.67
6 5/16 x 4 5/16 x 11/16	6.70	22.33	22.78
6⅜ x 4⅜ x ¾	7.32	24.40	24.89
6 7/16 x 4 7/16 x 13/16	7.94	26.47	27.00
6½ x 4½ x ⅞	8.56	28.53	29.10
6 9/16 x 4 9/16 x 15/16	9.18	30.60	31.21
6⅝ x 4⅝ x 1	9.80	32.67	33.32
6 x 3½ x 3/8	3.39	11.30	11.53
6 1/16 x 3 9/16 x 7/16	3.99	13.30	13.57
6¼ x 3⅜ x ½	4.59	15.30	15.61
6 3/16 x 3 11/16 x 9/16	5.19	17.30	17.65
6¼ x 3¾ x ⅝	5.79	19.30	19.69
6 5/16 x 3 13/16 x 11/16	6.39	21.30	21.73
6⅜ x 3⅞ x ¾	6.99	23.30	23.57
6 7/16 x 3 15/16 x 13/16	7.59	25.30	25.81
6½ x 4 x 7/8	8.19	27.30	27.85
6 9/16 x 4 1/16 x 15/16	8.79	29.30	29.89
6⅝ x 4⅛ x 1	9.39	31.30	31.93
5½ x 3½ x 3/8	3.23	10.77	10.98
5 9/16 x 3 9/16 x 7/16	3.76	12.53	12.78
5⅝ x 3⅜ x ½	4.29	14.30	14.59
5 11/16 x 3 11/16 x 9/16	4.82	16.07	16.39
5¾ x 3¾ x ⅝	5.35	17.83	18.19
5 x 4 x 3/8	3.23	10.77	10.98
5 1/16 x 4 1/16 x 7/16	3.76	12.53	12.78
5⅛ x 4¼ x ½	4.29	14.30	14.59
5 3/16 x 4 3/16 x 9/16	4.82	16.07	16.39
5¼ x 4¼ x ⅝	5.35	17.83	18.19
5 5/16 x 4 5/16 x 11/16	5.88	19.60	19.99
5⅜ x 4⅜ x ¾	6.41	21.36	21.79
5 x 3½ x 5/16	2.56	8.53	8.70
5 1/16 x 3 9/16 x 3/8	3.04	10.13	10.34
5⅛ x 3⅜ x 7/16	3.52	11.73	11.97
5 3/16 x 3 11/16 x ½	4.00	13.33	13.60
5¼ x 3¾ x 9/16	4.48	14.93	15.23
5 5/16 x 3 13/16 x ⅝	4.96	16.53	16.86
5⅜ x 3⅞ x 11/16	5.44	18.13	18.50
5 7/16 x 3 15/16 x ¾	5.92	19.73	20.13
5 x 3 x 5/16	2.40	8.00	8.16
5 1/16 x 3 1/16 x 3/8	2.85	9.50	9.69
5⅛ x 3⅛ x 7/16	3.30	11.00	11.22
5 3/16 x 3 3/16 x ½	3.75	12.50	12.75
5¼ x 3¼ x 9/16	4.20	14.00	14.28
5 5/16 x 3 5/16 x ⅝	4.65	15.50	15.81
5⅜ x 3⅜ x 11/16	5.10	17.00	17.34
5 7/16 x 3 7/16 x ¾	5.55	18.50	18.87
4½ x 3 x 5/16	2.27	7.57	7.72
4 9/16 x 3 1/16 x 3/8	2.70	9.00	9.18
4⅝ x 3⅛ x 7/16	3.13	10.43	10.64
4 11/16 x 3 3/16 x ½	3.56	11.87	12.10
4¾ x 3¼ x 9/16	3.99	13.30	13.57
4 13/16 x 3 5/16 x ⅝	4.42	14.73	15.03
4⅞ x 3⅜ x 11/16	4.85	16.17	16.49
4 15/16 x 3 7/16 x ¾	5.28	17.60	17.95

PENCOYD ANGLES.

IRON AND STEEL.

Size, area and weight per foot of various thicknesses in pounds.
Actual lengths of legs corresponding to given thicknesses.

Size.	Area.	Weight per Foot.		Size.	Area.	Weight per Foot.	
		Iron.	Steel.			Iron.	Steel.
4 x 3½ x 5/16	2.27	7.57	7.72	3 x 2½ x ¼	1.31	4.37	4.45
4 1/16 x 3 9/16 x 3/8	2.70	9.00	9.18	3 1/16 x 2 9/16 x 5/16	1.64	5.47	5.58
4¼ x 3⅜ x 7/16	3.13	10.43	10.64	3⅛ x 2⅜ x 3/8	1.97	6.57	6.70
4 3/16 x 3 11/16 x ½	3.56	11.87	12.10	3 3/16 x 2 11/16 x 7/16	2.30	7.67	7.82
4¼ x 3¾ x 9/16	3.99	13.30	13.57	3¼ x 2¾ x ½	2.63	8.77	8.44
4 5/16 x 3 13/16 x 5/8	4.42	14.73	15.03				
4⅜ x 3⅞ x 11/16	4.85	16.17	16.49	3 x 2 x ¼	1.20	4.00	4.08
4 7/16 x 3 15/16 x ¾	5.28	17.60	17.95	3 1/16 x 2 1/16 x 5/16	1.50	5.00	5.10
				3⅛ x 2⅛ x 3/8	1.80	6.00	6.12
4 x 3 x 5/16	2.09	6.97	7.11	3 3/16 x 2 3/16 x 7/16	2.10	7.00	7.14
4 1/16 x 3 1/16 x 3/8	2.51	8.37	8.53	3¼ x 2¼ x ½	2.40	8.00	8.16
4⅛ x 3⅛ x 7/16	2.93	9.77	9.96				
4 3/16 x 3 3/16 x ½	3.35	11.17	11.39	2½ x 2 x 5/16	0.79	2.63	2.69
4¼ x 3¼ x 9/16	3.77	12.57	12.82	2 9/16 x 2 1/16 x ¼	1.05	3.50	3.57
4 5/16 x 3 5/16 x 5/8	4.19	13.97	14.24	2⅝ x 2⅛ x 5/16	1.31	4.37	4.45
				2 11/16 x 2 3/16 x 3/8	1.59	5.30	5.41
3½ x 3 x 5/16	1.93	6.43	6.56	2¾ x 2¼ x 7/16	1.86	6.20	6.32
3 9/16 x 3 1/16 x 3/8	2.32	7.73	7.89	2 13/16 x 2 5/16 x ½	2.12	7.07	7.21
3⅝ x 3⅛ x 7/16	2.70	9.00	9.18				
3 1/16 x 3 3/16 x ½	3.09	10.30	10.51	2¼ x 1½ x 5/16	0.67	2.23	2.28
3¾ x 3¼ x 9/16	3.48	11.60	11.83	2 5/16 x 1 9/16 x ¼	0.89	2.97	3.03
3 3/16 x 3 5/16 x 5/8	3.86	12.87	13.12	2⅜ x 1⅝ x 5/16	1.11	3.70	3.74
				2 7/16 x 1 11/16 x 3/8	1.34	4.47	4.56
3½ x 2½ x ½	1.45	4.83	4.93				
3 9/16 x 2 9/16 x 5/16	1.78	5.93	6.05	2 x 1¼ x 5/16	0.57	1.90	1.94
3⅝ x 2⅝ x 3/8	2.11	7.03	7.17	2 1/16 x 1 5/16 x ¼	0.78	2.60	2.65
3 11/16 x 2 11/16 x 7/16	2.44	8.13	8.30	2⅛ x 1⅜ x 5/16	0.98	3.27	3.33
3¾ x 2¾ x ½	2.77	9.23	9.42	2 3/16 x 1 7/16 x 3/8	1.17	3.90	3.98
3½ x 2 x 15/64	1.21	4.03	4.11				
3½ x 2 x ¼	1.31	4.37	4.45				
3 3/16 x 2 1/16 x 5/16	1.64	5.47	5.58				
3⅝ x 2⅛ x 3/8	1.97	6.57	6.70				

NOTE.—In angles with uneven legs, the length of the long leg and the thickness of the short leg is a little less than that given in the tables.

SQUARE AND ROUND BARS OF IRON AND STEEL.

For iron, $3\frac{1}{3}$ / For steel, 3.4 } times the sectional area in square inches equals the weight per lineal foot in pounds, on the basis of iron weighing 480, or steel 489.6 pounds per cubic foot.

Thickness or Diameter in Inches.	Weight per Lineal Foot in Pounds.				Area of Square in Square Inches.	Area of Round in Square Inches.	Circumference of Round in Inches.
	Square.		Round.				
	Iron.	Steel.	Iron.	Steel.			
0							
1/16	.013	.013	.010	.010	.0039	.0031	.1963
1/8	.052	.053	.041	.042	.0156	.0123	.3927
3/16	.117	.119	.092	.094	.0352	.0276	.5890
1/4	.208	.212	.164	.167	.0625	.0491	.7854
5/16	.326	.333	.256	.261	.0977	.0767	.9817
3/8	.469	.478	.368	.375	.1406	.1104	1.1781
7/16	.638	.651	.501	.511	.1914	.1503	1.3744
1/2	.833	.850	.654	.667	.2500	.1963	1.5708
9/16	1.055	1.076	.828	.845	.3164	.2485	1.7671
5/8	1.302	1.328	1.023	1.043	.3906	.3068	1.9635
11/16	1.576	1.608	1.237	1.259	.4727	.3712	2.1598
3/4	1.875	1.913	1.473	1.502	.5625	.4418	2.3562
13/16	2.201	2.245	1.728	1.763	.6602	.5185	2.5525
7/8	2.552	2.603	2.004	2.044	.7656	.6013	2.7489
15/16	2.930	2.989	2.301	2.347	.8789	.6903	2.9452
1	3.333	3.400	2.618	2.670	1.0000	.7854	3.1416
1/16	3.763	3.838	2.955	3.014	1.1289	.8866	3.3379
1/8	4.219	4.303	3.313	3.379	1.2656	.9940	3.5343
3/16	4.701	4.795	3.692	3.766	1.4102	1.1075	3.7306
1/4	5.208	5.312	4.091	4.173	1.5625	1.2272	3.9270
5/16	5.742	5.857	4.510	4.600	1.7227	1.3530	4.1233
3/8	6.302	6.428	4.950	5.049	1.8906	1.4849	4.3197
7/16	6.888	7.026	5.410	5.518	2.0664	1.6230	4.5160
1/2	7.500	7.650	5.890	6.008	2.2500	1.7671	4.7124
9/16	8.138	8.301	6.392	6.520	2.4414	1.9175	4.9087
5/8	8.802	8.978	6.913	7.051	2.6406	2.0739	5.1051
11/16	9.492	9.682	7.455	7.604	2.8477	2.2365	5.3014
3/4	10.21	10.41	8.018	8.178	3.0625	2.4053	5.4978
13/16	10.95	11.17	8.601	8.773	3.2852	2.5802	5.6941
7/8	11.72	11.95	9.204	9.388	3.5156	2.7612	5.8905
15/16	12.51	12.76	9.828	10.03	3.7539	2.9483	6.0868
2	13.33	13.60	10.47	10.68	4.0000	3.1416	6.2832
1/16	14.18	14.46	11.14	11.36	4.2539	3.3410	6.4795
1/8	15.05	15.35	11.82	12.06	4.5156	3.5466	6.6759
3/16	15.95	16.27	12.53	12.78	4.7852	3.7583	6.8722
1/4	16.88	17.22	13.25	13.52	5.0625	3.9761	7.0686
5/16	17.83	18.19	14.00	14.28	5.3477	4.2000	7.2649
3/8	18.80	19.18	14.77	15.07	5.6406	4.4301	7.4613
7/16	19.80	20.20	15.55	15.86	5.9414	4.6664	7.6576
1/2	20.83	21.25	16.36	16.69	6.2500	4.9087	7.8540

SQUARE AND ROUND BARS OF IRON AND STEEL.—Continued.

Thickness or Diameter in Inches.	Weight per Lineal Foot in Pounds.				Area of Square in Square Inches.	Area of Round in Square Inches.	Circumference of Round in Inches.
	Square.		Round.				
	Iron.	Steel.	Iron.	Steel.			
2 9/16	21.89	22.33	17.19	17.53	6.5664	5.1572	8.0503
5/8	22.97	23.43	18.04	18.40	6.8906	5.4119	8.2467
11/16	24.08	24.56	18.91	19.29	7.2227	5.6727	8.4430
3/4	25.21	25.71	19.80	20.20	7.5625	5.9396	8.6394
13/16	26.37	26.90	20.71	21.12	7.9102	6.2126	8.8357
7/8	27.55	28.10	21.64	22.07	8.2656	6.4918	9.0321
15/16	28.76	29.34	22.59	23.04	8.6289	6.7771	9.2284
3	30.00	30.60	23.56	24.03	9.0000	7.0686	9.4248
1/16	31.26	31.89	24.55	25.04	9.3789	7.3662	9.6211
1/8	32.55	33.20	25.57	26.08	9.7656	7.6699	9.8175
3/16	33.87	34.55	26.60	27.13	10.160	7.9798	10.014
1/4	35.21	35.91	27.65	28.20	10.563	8.2958	10.210
5/16	36.58	37.31	28.73	29.00	10.973	8.6179	10.407
3/8	37.97	38.73	29.82	30.42	11.391	8.9462	10.603
7/16	39.39	40.18	30.94	31.56	11.816	9.2806	10.799
1/2	40.83	41.65	32.07	32.71	12.250	9.6211	10.996
9/16	42.30	43.15	33.23	33.89	12.691	9.9678	11.192
5/8	43.80	44.68	34.40	35.09	13.141	10.321	11.388
11/16	45.33	46.24	35.60	36.31	13.598	10.680	11.585
3/4	46.88	47.82	36.82	37.56	14.063	11.045	11.781
13/16	48.45	49.42	38.05	38.81	14.535	11.416	11.977
7/8	50.05	51.05	39.31	40.10	15.016	11.793	12.174
15/16	51.68	52.71	40.59	41.40	15.504	12.177	12.370
4	53.33	54.40	41.89	42.73	16.000	12.566	12.566
1/16	55.01	56.11	43.21	44.07	16.504	12.962	12.763
1/8	56.72	57.85	44.55	45.44	17.016	13.364	12.959
3/16	58.45	59.62	45.91	46.83	17.535	13.772	13.155
1/4	60.21	61.41	47.29	48.24	18.063	14.186	13.352
5/16	61.99	63.23	48.69	49.66	18.598	14.607	13.548
3/8	63.80	65.08	50.11	51.11	19.141	15.033	13.744
7/16	65.64	66.95	51.55	52.58	19.691	15.466	13.941
1/2	67.50	68.85	53.01	54.07	20.250	15.904	14.137
9/16	69.39	70.78	54.50	55.59	20.816	16.349	14.334
5/8	71.30	72.73	56.00	57.12	21.391	16.800	14.530
11/16	73.24	74.70	57.52	58.67	21.973	17.257	14.726
3/4	75.21	76.71	59.04	60.22	22.563	17.721	14.923
13/16	77.20	78.74	60.63	61.84	23.160	18.190	15.119
7/8	79.22	80.80	62.22	63.46	23.766	18.665	15.315
15/16	81.26	82.88	63.82	65.09	24.379	19.147	15.512
5	83.33	85.00	65.45	66.76	25.000	19.635	15.708
1/16	85.43	87.14	67.10	68.44	25.629	20.129	15.904
1/8	87.55	89.30	68.76	70.14	26.266	20.629	16.101
3/16	89.70	91.49	70.45	71.86	26.910	21.135	16.297
1/4	91.88	93.72	72.16	73.60	27.563	21.648	16.493

SQUARE AND ROUND BARS OF IRON AND STEEL.—Continued.

Thickness or Diameter in Inches.	Weight per Lineal Foot in Pounds.				Area of Square in Square Inches.	Area of Round in Square Inches.	Circumference of Round in Inches.
	Square.		Round.				
	Iron.	Steel.	Iron.	Steel.			
5 5/16	94.08	95.96	73.89	75.37	28.223	22.166	16.690
3/8	96.30	98.23	75.64	77.15	28.891	22.691	16.886
7/16	98.55	100.5	77.40	78.95	29.566	23.221	17.082
1/2	100.8	102.8	79.19	80.77	30.250	23.758	17.279
9/16	103.1	105.2	81.00	82.62	30.941	24.301	17.475
5/8	105.5	107.6	82.83	84.49	31.641	24.850	17.671
11/16	107.8	110.0	84.69	86.38	32.348	25.406	17.868
3/4	110.2	112.4	86.56	88.29	33.063	25.967	18.064
13/16	112.6	114.9	88.45	90.22	33.785	26.535	18.261
7/8	115.1	117.4	90.36	92.17	34.516	27.109	18.457
15/16	117.5	119.9	92.29	94.14	35.254	27.688	18.653
6	120.0	122.4	94.25	96.14	36.000	28.274	18.850
1/16	122.5	125.0	96.22	98.14	36.754	28.866	19.046
1/2	125.1	127.6	98.23	100.2	37.516	29.465	19.242
3/16	127.6	130.2	100.2	102.2	38.285	30.069	19.439
1/4	130.2	132.8	102.3	104.3	39.063	30.680	19.635
5/16	132.8	135.5	104.3	106.4	39.848	31.296	19.831
3/8	135.5	138.2	106.4	108.5	40.641	31.919	20.028
7/16	138.1	140.9	108.5	110.7	41.441	32.548	20.224
1/2	140.8	143.6	110.6	112.8	42.250	33.183	20.420
9/16	143.6	146.5	112.7	115.0	43.066	33.824	20.617
5/8	146.3	149.2	114.9	117.2	43.891	34.472	20.813
11/16	149.1	152.1	117.1	119.4	44.723	35.125	21.009
3/4	151.9	154.9	119.3	121.7	45.563	35.785	21.206
13/16	154.7	157.8	121.5	123.9	46.410	36.450	21.402
7/8	157.6	160.7	123.7	126.2	47.266	37.122	21.598
15/16	160.4	163.6	126.0	128.5	48.129	37.800	21.795
7	163.3	166.5	128.3	128.6	49.000	38.485	21.991
1/16	166.3	166.6	130.6	130.9	49.879	39.175	22.187
1/8	169.2	172.6	132.9	135.6	50.766	39.871	22.384
3/16	172.2	175.6	135.2	137.9	51.660	40.574	22.580
1/4	175.2	178.7	137.6	140.4	52.563	41.282	22.777
5/16	178.2	171.8	140.0	142.8	53.473	41.997	22.973
3/8	181.3	184.9	142.4	145.2	54.391	42.718	23.169
7/16	184.4	188.1	144.8	147.7	55.316	43.445	23.366
1/2	187.5	191.3	147.3	150.2	56.250	44.179	23.562
9/16	190.6	194.4	149.7	152.7	57.191	44.918	23.758
5/8	193.8	197.7	152.2	155.2	58.141	45.664	23.955
11/16	197.0	201.0	154.7	158.0	59.098	46.415	24.151
3/4	200.2	204.2	157.2	160.3	60.063	47.173	24.347
13/16	203.5	207.6	159.8	163.0	61.035	47.937	24.544
7/8	206.7	210.8	162.4	165.6	62.016	48.707	24.740
15/16	210.0	214.2	164.9	168.2	63.004	49.483	24.936

FLAT BARS OF IRON OR STEEL.

AREA AND WEIGHTS PER LINEAL FOOT.

Width in Inches.	1/16" Thick.			1/8" Thick.			3/16" Thick.		
	Area in Square Inches.	Pounds per Foot.		Area in Square Inches	Pounds per Foot.		Area in Square Inches.	Pounds per Foot.	
		Iron.	Steel.		Iron.	Steel.		Iron.	Steel.
1	.063	.208	.213	.125	.417	.425	.188	.625	.638
1 1/8	.070	.233	.238	.141	.469	.478	.211	.703	.719
1 1/4	.078	.260	.265	.156	.521	.531	.234	.781	.797
1 3/8	.086	.287	.292	.172	.573	.584	.258	.859	.876
1 1/2	.094	.313	.320	.188	.625	.638	.281	.938	.957
1 5/8	.102	.339	.346	.203	.677	.691	.305	1.02	1.04
1 3/4	.109	.365	.372	.219	.729	.744	.328	1.09	1.11
1 7/8	.117	.391	.399	.234	.781	.797	.352	1.17	1.19
2	.125	.417	.425	.250	.833	.850	.375	1.25	1.28
2 1/8	.133	.443	.452	.266	.886	.904	.398	1.33	1.36
2 1/4	.141	.469	.478	.281	.938	.957	.422	1.41	1.44
2 3/8	.148	.495	.505	.297	.990	1.01	.445	1.48	1.51
2 1/2	.156	.521	.531	.313	1.04	1.06	.469	1.56	1.59
2 5/8	.164	.547	.558	.328	1.09	1.11	.492	1.64	1.67
2 3/4	.172	.573	.584	.344	1.15	1.17	.516	1.72	1.75
2 7/8	.180	.599	.611	.359	1.20	1.22	.539	1.80	1.84
3	.188	.625	.638	.375	1.25	1.28	.563	1.88	1.91
3 1/4	.203	.677	.691	.406	1.35	1.38	.609	2.03	2.07
3 1/2	.219	.729	.744	.438	1.46	1.49	.656	2.19	2.23
3 3/4	.234	.781	.797	.469	1.56	1.59	.703	2.34	2.39
4	.250	.833	.850	.500	1.67	1.70	.750	2.50	2.55
4 1/4	.266	.885	.903	.531	1.77	1.81	.797	2.66	2.71
4 1/2	.281	.938	.957	.563	1.88	1.92	.844	2.81	2.87
4 3/4	.297	.990	1.01	.594	1.98	2.02	.891	2.97	3.03
5	.313	1.04	1.06	.625	2.08	2.12	.938	3.13	3.19
5 1/4	.328	1.09	1.11	.656	2.19	2.23	.984	3.28	3.35
5 1/2	.344	1.15	1.17	.688	2.29	2.34	1.03	3.44	3.51
5 3/4	.359	1.20	1.22	.719	2.40	2.45	1.08	3.59	3.67
6	.375	1.25	1.28	.750	2.50	2.55	1.13	3.75	3.83
6 1/2	.406	1.35	1.38	.813	2.71	2.76	1.22	4.06	4.14
7	.438	1.46	1.49	.875	2.92	2.98	1.31	4.38	4.66
8	.500	1.67	1.70	1.00	3.33	3.40	1.50	5.00	5.10
9	.563	1.88	1.92	1.13	3.75	3.83	1.69	5.63	5.74
10	.625	2.08	2.12	1.25	4.17	4.25	1.88	6.25	6.38
11	.688	2.29	2.34	1.38	4.58	4.67	2.06	6.88	7.02
12	.750	2.50	2.55	1.50	5.00	5.10	2.25	7.50	7.65

FLAT BARS OF IRON OR STEEL.

AREA AND WEIGHTS PER LINEAL FOOT.

Width in Inches.	1/4" Thick.			5/16" Thick.			3/8" Thick.		
	Area in Square Inches.	Pounds per Foot.		Area in Square Inches	Pounds per Foot.		Area in Square Inches.	Pounds per Foot.	
		Iron.	Steel.		Iron.	Steel.		Iron.	Steel.
1	.250	.833	.850	.313	1.04	1.06	.375	1.25	1.28
1 1/8	.281	.938	.957	.352	1.17	1.19	.422	1.41	1.44
1 1/4	.313	1.04	1.06	.391	1.30	1.33	.469	1.56	1.59
1 3/8	.344	1.15	1.17	.430	1.43	1.46	.516	1.72	1.75
1 1/2	.375	1.25	1.28	.469	1.56	1.59	.563	1.88	1.92
1 5/8	.406	1.36	1.39	.508	1.69	1.72	.609	2.03	2.07
1 3/4	.438	1.46	1.49	.547	1.82	1.86	.656	2.19	2.23
1 7/8	.469	1.56	1.59	.586	1.95	1.99	.703	2.34	2.39
2	.500	1.67	1.70	.625	2.08	2.12	.750	2.50	2.55
2 1/8	.531	1.77	1.81	.664	2.21	2.25	.797	2.65	2.70
2 1/4	.563	1.88	1.92	.703	2.34	2.39	.844	2.81	2.87
2 3/8	.594	1.98	2.02	.742	2.47	2.52	.891	2.97	3.03
2 1/2	.625	2.08	2.12	.781	2.60	2.65	.938	3.13	3.19
2 5/8	.656	2.19	2.23	.820	2.73	2.78	.984	3.28	3.35
2 3/4	.688	2.29	2.34	.859	2.86	2.92	1.03	3.44	3.51
2 7/8	.719	2.40	2.45	.898	3.00	3.06	1.08	3.60	3.67
3	.750	2.50	2.55	.938	3.13	3.19	1.13	3.75	3.83
3 1/4	.813	2.71	2.76	1.02	3.39	3.45	1.22	4.06	4.15
3 1/2	.875	2.92	2.98	1.09	3.65	3.72	1.31	4.38	4.47
3 3/4	.938	3.13	3.19	1.17	3.91	3.99	1.41	4.69	4.78
4	1.00	3.33	3.40	1.25	4.17	4.25	1.50	5.00	5.10
4 1/4	1.06	3.54	3.61	1.33	4.43	4.52	1.59	5.31	5.42
4 1/2	1.13	3.75	3.83	1.41	4.69	4.78	1.69	5.63	5.74
4 3/4	1.19	3.96	4.04	1.48	4.95	5.05	1.78	5.94	6.06
5	1.25	4.17	4.25	1.56	5.21	5.31	1.88	6.25	6.38
5 1/4	1.31	4.38	4.46	1.64	5.47	5.58	1.97	6.56	6.69
5 1/2	1.38	4.58	4.67	1.72	5.73	5.84	2.06	6.88	7.02
5 3/4	1.44	4.79	4.89	1.80	5.99	6.11	2.16	7.19	7.34
6	1.50	5.00	5.10	1.88	6.25	6.38	2.25	7.50	7.65
6 1/2	1.63	5.42	5.53	2.03	6.77	6.90	2.44	8.13	8.29
7	1.75	5.83	5.95	2.19	7.29	7.44	2.63	8.75	8.93
8	2.00	6.67	6.80	2.50	8.33	8.50	3.00	10.00	10.2
9	2.25	7.50	7.65	2.81	9.38	9.56	3.38	11.25	11.48
10	2.50	8.33	8.50	3.13	10.42	10.64	3.75	12.50	12.75
11	2.75	9.17	9.35	3.44	11.46	11.70	4.13	13.75	14.03
12	3.00	10.00	10.2	3.75	12.50	12.75	4.50	15.00	15.30

FLAT BARS OF IRON OR STEEL.

AREA AND WEIGHTS PER LINEAL FOOT.

Width in Inches.	7/16″ Thick.			1/2″ Thick.			9/16″ Thick.		
	Area in Square Inches.	Pounds per Foot.		Area in Square Inches	Pounds per Foot.		Area in Square Inches.	Pounds per Foot.	
		Iron.	Steel.		Iron.	Steel.		Iron.	Steel.
1	.438	1.46	1.49	.500	1.67	1.70	.563	1.88	1.92
1 1/8	.481	1.64	1.67	.563	1.87	1.91	.618	2.06	2.10
1 1/4	.547	1.82	1.86	.625	2.08	2.12	.703	2.34	2.39
1 3/8	.602	2.01	2.05	.688	2.29	2.34	.773	2.58	2.63
1 1/2	.656	2.19	2.23	.750	2.50	2.55	.844	2.81	2.87
1 5/8	.711	2.37	2.42	.813	2.71	2.76	.914	3.05	3.11
1 3/4	.766	2.55	2.60	.875	2.92	2.98	.984	3.28	3.35
1 7/8	.820	2.73	2.78	.938	3.12	3.18	1.05	3.50	3.57
2	.875	2.92	2.98	1.00	3.33	3.40	1.13	3.75	3.83
2 1/8	.930	3.10	3.16	1.06	3.54	3.61	1.20	4.00	4.08
2 1/4	.984	3.28	3.35	1.13	3.75	3.83	1.27	4.22	4.30
2 3/8	1.04	3.46	3.53	1.19	3.96	4.04	1.34	4.46	4.55
2 1/2	1.09	3.65	3.72	1.25	4.17	4.25	1.41	4.69	4.78
2 5/8	1.15	3.83	3.91	1.31	4.38	4.47	1.48	4.92	5.02
2 3/4	1.20	4.01	4.09	1.38	4.58	4.67	1.55	5.16	5.26
2 7/8	1.26	4.20	4.28	1.44	4.79	4.89	1.62	5.39	5.50
3	1.31	4.38	4.46	1.50	5.00	5.10	1.69	5.63	5.74
3 1/4	1.42	4.74	4.83	1.63	5.42	5.53	1.83	6.09	6.22
3 1/2	1.53	5.10	5.20	1.75	5.83	5.95	1.97	6.56	6.70
3 3/4	1.64	5.47	5.58	1.88	6.25	6.38	2.11	7.03	7.17
4	1.75	5.83	5.95	2.00	6.67	6.80	2.25	7.50	7.65
4 1/4	1.86	6.20	6.32	2.13	7.08	7.22	2.39	7.97	8.13
4 1/2	1.97	6.56	6.70	2.25	7.50	7.65	2.53	8.44	8.61
4 3/4	2.08	6.93	7.07	2.38	7.92	8.08	2.67	8.91	9.09
5	2.19	7.29	7.44	2.50	8.33	8.50	2.81	9.38	9.57
5 1/4	2.30	7.66	7.81	2.63	8.75	8.93	2.95	9.84	10.04
5 1/2	2.41	8.02	8.18	2.75	9.17	9.35	3.09	10.31	10.52
5 3/4	2.52	8.39	8.56	2.88	9.58	9.77	3.23	10.78	11.00
6	2.63	8.75	8.93	3.00	10.00	10.20	3.38	11.25	11.48
6 1/2	2.84	9.48	9.67	3.25	10.83	11.05	3.66	12.19	12.43
7	3.06	10.21	10.41	3.50	11.67	11.90	3.94	13.13	13.39
8	3.50	11.67	11.90	4.00	13.33	13.60	4.50	15.00	15.30
9	3.94	13.13	13.40	4.50	15.00	15.30	5.06	16.88	17.22
10	4.38	14.58	14.88	5.00	16.67	17.00	5.63	18.75	19.14
11	4.81	16.04	16.36	5.50	18.33	18.70	6.19	20.63	21.05
12	5.25	17.50	17.85	6.00	20.00	20.40	6.75	22.50	22.95

FLAT BARS OF IRON OR STEEL.

AREA AND WEIGHTS PER LINEAL FOOT.

Width in Inches.	5/8″ Thick.			11/16″ Thick.			3/4″ Thick.		
	Area in Square Inches.	Pounds per Foot.		Area in Square Inches	Pounds per Foot.		Area in Square Inches.	Pounds per Foot.	
		Iron.	Steel.		Iron.	Steel.		Iron.	Steel.
1	.625	2.08	2.12	.688	2.29	2.34	.750	2.50	2.55
1 1/8	.687	2.34	2.39	.756	2.52	2.57	.825	2.81	2.86
1 1/4	.781	2.60	2.65	.859	2.86	2.92	.938	3.13	3.19
1 3/8	.859	2.86	2.92	.945	3.15	3.21	1.03	3.44	3.51
1 1/2	.938	3.13	3.19	1.03	3.44	3.51	1.13	3.75	3.83
1 5/8	1.02	3.39	3.46	1.12	3.73	3.80	1.22	4.06	4.14
1 3/4	1.09	3.65	3.72	1.20	4.01	4.09	1.31	4.38	4.47
1 7/8	1.17	3.91	3.99	1.29	4.30	4.39	1.41	4.69	4.78
2	1.25	4.17	4.25	1.38	4.58	4.67	1.50	5.00	5.10
2 1/8	1.33	4.43	4.52	1.46	4.87	4.97	1.59	5.31	5.42
2 1/4	1.41	4.69	4.78	1.55	5.16	5.26	1.69	5.63	5.74
2 3/8	1.48	4.95	5.05	1.63	5.44	5.55	1.78	5.94	6.06
2 1/2	1.56	5.21	5.31	1.72	5.73	5.84	1.88	6.25	6.38
2 5/8	1.64	5.47	5.58	1.80	6.01	6.13	1.97	6.56	6.69
2 3/4	1.72	5.73	5.84	1.89	6.30	6.43	2.06	6.88	7.02
2 7/8	1.80	5.99	6.11	1.98	6.59	6.72	2.16	7.19	7.33
3	1.88	6.25	6.38	2.06	6.88	7.02	2.25	7.50	7.65
3 1/4	2.03	6.77	6.91	2.23	7.45	7.60	2.44	8.13	8.29
3 1/2	2.19	7.29	7.44	2.41	8.02	8.18	2.63	8.75	8.93
3 3/4	2.34	7.81	7.97	2.58	8.59	8.76	2.81	9.38	9.57
4	2.50	8.33	8.50	2.75	9.17	9.35	3.00	10.00	10.20
4 1/4	2.66	8.85	9.03	2.92	9.74	9.93	3.19	10.63	10.84
4 1/2	2.81	9.38	9.57	3.09	10.31	10.52	3.38	11.25	11.48
4 3/4	2.97	9.90	10.10	3.27	10.89	11.11	3.56	11.88	12.12
5	3.13	10.42	10.63	3.44	11.46	11.69	3.75	12.50	12.75
5 1/4	3.28	10.94	11.16	3.61	12.03	12.27	3.94	13.13	13.39
5 1/2	3.44	11.46	11.69	3.78	12.60	12.85	4.13	13.75	14.03
5 3/4	3.59	11.98	12.22	3.95	13.18	13.44	4.31	14.38	14.67
6	3.75	12.50	12.75	4.13	13.75	14.03	4.50	15.00	15.30
6 1/2	4.06	13.54	13.81	4.47	14.90	15.20	4.88	16.25	16.58
7	4.38	14.58	14.87	4.81	16.04	16.36	5.25	17.50	17.85
8	5.00	16.67	17.00	5.50	18.33	18.70	6.00	20.00	20.40
9	5.63	18.75	19.13	6.19	20.63	21.04	6.75	22.50	22.95
10	6.25	20.83	21.25	6.88	22.92	23.38	7.50	25.00	25.50
11	6.88	22.92	23.38	7.56	25.21	25.71	8.25	27.50	28.05
12	7.50	25.00	25.50	8.25	27.50	28.05	9.00	30.00	30.60

FLAT BARS OF IRON OR STEEL.

AREA AND WEIGHTS PER LINEAL FOOT.

Width in Inches.	13/16″ Thick.			7/8″ Thick.			15/16″ Thick.		
	Area in Square Inches.	Pounds per Foot.		Area in Square Inches	Pounds per Foot.		Area in Square Inches.	Pounds per Foot.	
		Iron.	Steel.		Iron.	Steel.		Iron.	Steel.
1	.813	2.71	2.76	.875	2.92	2.98	.938	3.13	3.19
1 1/8	.893	2.97	3.03	.962	3.28	3.35	1.03	3.44	3.51
1 1/4	1.02	3.39	3.45	1.09	3.65	3.72	1.17	3.91	3.99
1 3/8	1.12	3.73	3.80	1.20	4.01	4.09	1.29	4.30	4.39
1 1/2	1.22	4.06	4.14	1.31	4.38	4.47	1.41	4.69	4.78
1 5/8	1.32	4.40	4.49	1.42	4.74	4.83	1.52	5.08	5.18
1 3/4	1.42	4.74	4.83	1.53	5.10	5.20	1.64	5.47	5.58
1 7/8	1.52	5.08	5.18	1.64	5.47	5.58	1.76	5.86	5.98
2	1.63	5.42	5.53	1.75	5.83	5.95	1.88	6.25	6.38
2 1/8	1.73	5.76	5.88	1.86	6.20	6.32	1.99	6.64	6.77
2 1/4	1.83	6.09	6.21	1.97	6.56	6.69	2.11	7.03	7.17
2 3/8	1.93	6.43	6.56	2.08	6.93	7.07	2.23	7.42	7.57
2 1/2	2.03	6.77	6.91	2.19	7.29	7.44	2.34	7.81	7.97
2 5/8	2.13	7.11	7.25	2.30	7.66	7.81	2.46	8.20	8.36
2 3/4	2.23	7.45	7.60	2.41	8.02	8.18	2.58	8.59	8.77
2 7/8	2.34	7.79	7.95	2.52	8.39	8.56	2.70	8.99	9.17
3	2.44	8.13	8.29	2.63	8.75	8.93	2.81	9.38	9.57
3 1/4	2.64	8.80	8.98	2.84	9.48	9.67	3.05	10.16	10.36
3 1/2	2.84	9.48	9.67	3.06	10.21	10.41	3.28	10.94	11.16
3 3/4	3.05	10.16	10.36	3.28	10.94	11.16	3.52	11.72	11.95
4	3.25	10.83	11.05	3.50	11.67	11.90	3.75	12.50	12.75
4 1/4	3.45	11.51	11.74	3.72	12.40	12.65	3.98	13.28	13.55
4 1/2	3.66	12.19	12.43	3.94	13.13	13.39	4.22	14.06	14.34
4 3/4	3.86	12.86	13.12	4.16	13.85	14.13	4.45	14.84	15.14
5	4.06	13.54	13.81	4.38	14.58	14.87	4.69	15.63	15.94
5 1/4	4.27	14.22	14.50	4.59	15.31	15.62	4.92	16.41	16.74
5 1/2	4.47	14.90	15.20	4.81	16.04	16.36	5.16	17.19	17.53
5 3/4	4.67	15.57	15.88	5.03	16.77	17.11	5.39	17.97	18.33
6	4.88	16.25	16.58	5.25	17.50	17.85	5.63	18.75	19.13
6 1/2	5.28	17.60	17.95	5.69	18.96	19.34	6.09	20.31	20.72
7	5.69	18.96	19.34	6.13	20.42	20.83	6.56	21.88	22.32
8	6.50	21.67	22.10	7.00	23.33	23.80	7.50	25.00	25.50
9	7.31	24.38	24.86	7.88	26.25	26.78	8.44	28.13	28.69
10	8.13	27.08	27.62	8.75	29.17	29.75	9.38	31.25	31.88
11	8.94	29.79	30.39	9.63	32.08	32.72	10.31	34.38	35.06
12	9.75	32.50	33.15	10.50	35.00	35.70	11.25	37.50	38.25

FLAT BARS OF IRON OR STEEL.

AREA AND WEIGHTS PER LINEAL FOOT.

Width in Inches.	1″ Thick.			1 1/16″ Thick.			1 3/16″ Thick.		
	Area in Square Inches.	Pounds per Foot.		Area in Square Inches	Pounds per Foot.		Area in Square Inches.	Pounds per Foot.	
		Iron.	Steel.		Iron.	Steel.		Iron.	Steel.
1	1.00	3.33	3.40	1.06	3.54	3.61	1.19	3.96	4.04
1 1/8	1.13	3.75	3.83	1.17	3.89	3.97	1.31	4.35	4.44
1 1/4	1.25	4.17	4.25	1.33	4.43	4.52	1.48	4.95	5.05
1 3/8	1.38	4.58	4.67	1.46	4.87	4.97	1.63	5.44	5.55
1 1/2	1.50	5.00	5.10	1.59	5.31	5.42	1.78	5.94	6.06
1 5/8	1.63	5.42	5.53	1.73	5.75	5.87	1.93	6.43	6.56
1 3/4	1.75	5.83	5.95	1.86	6.20	6.32	2.08	6.93	7.07
1 7/8	1.88	6.25	6.38	1.99	6.64	6.77	2.23	7.42	7.57
2	2.00	6.67	6.80	2.13	7.08	7.22	2.38	7.92	8.08
2 1/8	2.13	7.08	7.22	2.26	7.53	7.68	2.52	8.41	8.58
2 1/4	2.25	7.50	7.65	2.39	7.97	8.13	2.67	8.91	9.09
2 3/8	2.38	7.92	8.08	2.52	8.41	8.58	2.82	9.40	9.59
2 1/2	2.50	8.33	8.50	2.66	8.85	9.03	2.97	9.90	10.10
2 5/8	2.63	8.75	8.93	2.79	9.30	9.49	3.12	10.39	10.60
2 3/4	2.75	9.17	9.35	2.92	9.74	9.93	3.27	10.89	11.11
2 7/8	2.88	9.58	9.77	3.05	10.18	10.38	3.41	11.38	11.61
3	3.00	10.00	10.20	3.19	10.63	10.84	3.56	11.88	12.12
3 1/4	3.25	10.83	11.05	3.45	11.51	11.74	3.86	12.86	13.12
3 1/2	3.50	11.67	11.90	3.72	12.40	12.65	4.16	13.85	14.13
3 3/4	3.75	12.50	12.75	3.98	13.28	13.55	4.45	14.84	15.14
4	4.00	13.33	13.60	4.25	14.17	14.45	4.75	15.83	16.15
4 1/4	4.25	14.17	14.45	4.52	15.05	15.35	5.05	16.82	17.16
4 1/2	4.50	15.00	15.30	4.78	15.94	16.26	5.34	17.81	18.17
4 3/4	4.75	15.83	16.15	5.05	16.82	17.16	5.64	18.80	19.18
5	5.00	16.67	17.00	5.31	17.71	18.06	5.94	19.79	20.19
5 1/4	5.25	17.50	17.85	5.58	18.59	18.96	6.23	20.78	21.20
5 1/2	5.50	18.33	18.70	5.84	19.48	19.87	6.53	21.77	22.21
5 3/4	5.75	19.17	19.55	6.11	20.36	20.77	6.83	22.76	23.22
6	6.00	20.00	20.40	6.38	21.25	21.68	7.13	23.75	24.23
6 1/2	6.50	21.67	22.10	6.91	23.02	23.48	7.72	25.73	26.24
7	7.00	23.33	23.80	7.44	24.79	25.29	8.31	27.71	28.26
8	8.00	26.67	27.20	8.50	28.33	28.90	9.50	31.67	32.30
9	9.00	30.00	30.60	9.56	31.88	32.52	10.69	35.63	36.34
10	10.00	33.33	34.00	10.63	35.42	36.13	11.88	39.58	40.38
11	11.00	36.67	37.40	11.69	38.96	39.74	13.06	43.54	44.41
12	12.00	40.00	40.80	12.75	42.50	43.35	14.25	47.50	48.45

WEIGHT OF PLATE IRON, PER LINEAL FOOT, IN POUNDS.

FOR STEEL, ADD 2 PER CENT.

Width in Inches.	*THICKNESS IN INCHES.*															
	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
12	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00
13	2.71	5.42	8.13	10.83	13.54	16.25	18.96	21.67	24.38	27.08	29.79	32.50	35.21	37.92	40.63	43.33
14	2.92	5.83	8.75	11.67	14.58	17.50	20.42	23.33	26.25	29.17	32.08	35.00	37.92	40.83	43.75	46.67
15	3.13	6.25	9.38	12.50	15.63	18.75	21.88	25.00	28.13	31.25	34.38	37.50	40.63	43.75	46.88	50.00
16	3.33	6.67	10.00	13.33	16.67	20.00	23.33	26.67	30.00	33.33	36.67	40.00	43.33	46.67	50.00	53.33
17	3.54	7.08	10.63	14.17	17.71	21.25	24.79	28.34	31.88	35.42	38.96	42.50	46.05	49.60	53.13	56.67
18	3.75	7.50	11.25	15.00	18.75	22.50	26.25	30.00	33.75	37.50	41.25	45.00	48.75	52.50	56.25	60.00
19	3.96	7.92	11.87	15.83	19.79	23.75	27.71	31.66	35.67	39.58	43.54	47.50	51.45	55.41	59.37	63.33
20	4.17	8.33	12.50	16.67	20.83	25.00	29.17	33.33	37.50	41.67	45.83	50.00	54.17	58.33	62.50	66.67
21	4.38	8.75	13.13	17.50	21.88	26.25	30.63	35.00	39.38	43.75	48.13	52.50	56.88	61.25	65.63	70.00
22	4.58	9.17	13.75	18.33	22.92	27.50	32.08	36.67	41.25	45.83	50.42	55.00	59.58	64.17	68.75	73.33
23	4.79	9.58	14.38	19.17	23.96	28.75	33.54	38.34	43.13	47.92	52.71	57.50	62.30	67.09	71.88	76.67
24	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00
25	5.21	10.42	15.62	20.83	26.04	31.25	36.46	41.66	46.87	52.08	57.29	62.50	67.70	72.91	78.12	83.33
26	5.42	10.83	16.25	21.67	27.08	32.50	37.92	43.33	48.75	54.17	59.58	65.00	70.42	75.83	81.25	86.67
27	5.63	11.25	16.88	22.50	28.13	33.75	39.38	45.00	50.63	56.25	61.88	67.50	73.13	78.75	84.38	90.00
28	5.83	11.67	17.50	23.33	29.17	35.00	40.83	46.67	52.50	58.33	64.17	70.00	75.84	81.66	87.50	93.33

WEIGHT OF PLATE IRON, PER LINEAL FOOT, IN POUNDS.—Continued.

FOR STEEL, ADD 2 PER CENT.

Width in Inches.	THICKNESS IN INCHES.															
	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
29	6.04	12.08	18.13	24.17	30.21	36.25	42.29	48.34	54.38	60.42	66.46	72.50	78.55	84.59	90.63	96.67
30	6.25	12.50	18.75	25.00	31.25	37.50	43.75	50.00	56.25	62.50	68.75	75.00	81.25	87.50	93.75	100.0
32	6.67	13.33	20.00	26.67	33.33	40.00	46.67	53.33	60.00	66.67	73.33	80.00	86.67	93.33	100.0	106.7
34	7.08	14.17	21.25	28.33	35.42	42.50	49.58	56.66	63.75	70.83	77.91	85.00	92.08	99.16	106.2	113.3
36	7.50	15.00	22.50	30.00	37.50	45.00	52.50	60.00	67.50	75.00	82.50	90.00	97.50	105.0	112.5	120.0
38	7.92	15.83	23.75	31.67	39.59	47.50	55.42	63.34	71.25	79.17	87.09	95.00	102.9	110.8	118.8	126.7
40	8.33	16.67	25.00	33.33	41.67	50.00	58.33	66.66	75.00	83.33	91.66	100.0	108.3	116.7	125.0	133.3
42	8.75	17.50	26.25	35.00	43.75	52.50	61.25	70.00	78.75	87.50	96.25	105.0	113.7	122.5	131.2	140.0
44	9.17	18.33	27.50	36.67	45.84	55.00	64.17	73.34	82.50	91.67	100.8	110.0	119.2	128.3	137.5	146.7
46	9.58	19.17	28.75	38.33	47.92	57.50	67.08	76.66	86.25	95.83	105.4	115.0	124.6	134.2	143.7	153.3
48	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.0	110.0	120.0	130.0	140.0	150.0	160.0
50	10.42	20.83	31.25	41.66	52.08	62.50	72.91	83.33	93.74	104.2	114.6	125.0	135.4	145.8	156.2	166.7
52	10.83	21.67	32.50	43.33	54.17	65.00	75.83	86.66	97.50	108.3	119.2	130.0	140.8	151.7	162.5	173.3
54	11.25	22.50	33.75	45.00	56.25	67.50	78.75	90.00	101.3	112.5	123.8	135.0	146.3	157.5	168.8	180.0
56	11.67	23.33	35.00	46.66	58.33	70.00	81.66	93.33	105.0	116.7	128.3	140.0	151.7	163.3	175.0	186.7
58	12.08	24.17	36.25	48.33	60.42	72.50	84.58	96.66	108.7	120.8	132.9	145.0	157.1	169.2	181.2	193.3
60	12.50	25.00	37.50	50.00	62.50	75.00	87.50	100.0	112.5	125.0	137.5	150.0	162.5	175.0	187.5	200.0

WEIGHT OF ROLLED SHEETS OF WROUGHT IRON AND STEEL.

CALCULATIONS BASED ON SPECIFIC GRAVITY OF 7.70 FOR IRON AND 7.85 FOR STEEL.

No. of Gauge.	*Birmingham Wire Gauge.*			*American (B. & S.) Wire Gauge.*		
	Thickness in Inches.	*Weight per Square Foot.*		*Thickness in Inches.*	*Weight per Square Foot.*	
		Iron.	*Steel.*		*Iron.*	*Steel.*
0000	.454	18.16	18.52	.46	18.40	18.76
000	.425	17.00	17.34	.4096	16.39	16.72
00	.38	15.20	15.50	.3648	14.59	14.88
0	.34	13.60	13.87	.3249	13.00	13.26
1	.3	12.00	12.24	.2893	11.57	11.80
2	.284	11.36	11.59	.2576	10.31	10.52
3	.259	10.35	10.56	.2294	9.18	9.36
4	.238	9.52	9.71	.2043	8.17	8.33
5	.22	8.80	8.98	.1819	7.27	7.42
6	.203	8.12	8.28	.1620	6.48	6.61
7	.18	7.19	7.34	.1443	5.77	5.88
8	.165	6.60	6.73	.1285	5.14	5.24
9	.148	5.92	6.04	.1144	4.57	4.66
10	.134	5.36	5.47	.1019	4.07	4.15
11	.12	4.80	4.89	.0907	3.63	3.70
12	.109	4.35	4.44	.0808	3.23	3.29
13	.095	3.80	3.87	.0720	2.88	2.93
14	.083	3.32	3.38	.0641	2.56	2.61
15	.072	2.88	2.94	.0571	2.28	2.32
16	.065	2.60	2.65	.0508	2.03	2.07
17	.058	2.32	2.37	.0453	1.81	1.84
18	.049	1.96	1.99	.0403	1.61	1.64
19	.042	1.68	1.71	.0359	1.43	1.46
20	.035	1.39	1.42	.0320	1.27	1.30
21	.032	1.27	1.30	.0285	1.13	1.16
22	.028	1.11	1.14	.0253	1.01	1.03
23	.025	.997	1.02	.0226	.903	.921
24	.022	.880	.898	.0201	.805	.821
25	.02	.800	.816	.0179	.715	.729
26	.018	.719	.734	.0159	.638	.651
27	.016	.640	.653	.0142	.570	.581
28	.014	.560	.571	.0126	.505	.515
29	.013	.520	.531	.0113	.450	.459
30	.012	.480	.489	.0100	.400	.409
31	.01	.399	.408	.0089	.357	.364
32	.009	.359	.367	.0080	.318	.324
33	.008	.320	.326	.0071	.283	.288
34	.007	.280	.286	.0063	.252	.257
35	.005	.200	.204	.0056	.224	.228
36	.004	.159	.162	.0050	.200	.204

OPEN-HEARTH STEEL AXLES.

Axles for locomotive and car service are made at Pencoyd of open-hearth steel, to conform to either the drop or mechanical test, as may be required.

The results below, taken as an average of a number of tests, represent the quality of material used for this purpose.

TRANSVERSE TEST.

Number of Axles.	*Diameter of Hub Seat.*	*Diameter of Centre.*	*Weight of Ram.*	*Height of Fall.*	*Number of Blows.*
14	$5\frac{1}{2}$	$4\frac{5}{8}$	1640	29	36
26	$5\frac{3}{16}$	$4\frac{3}{8}$	1640	25	37

TENSILE TEST.

	Elastic Limit.	*Ultimate Strength.*	*Elongation.*	*Reduction of Area.*
Average of 12 tests.	45320	79230	In 2″. 22.7 %	38 %

The blooms are worked at a single uniform heat, under heavy hammers, to the finished forging. Locomotive and passenger car-axles are furnished rough-turned throughout; those for freight service, with journals forged and rough-turned.

The process of manufacture thus indicated produces axles of the highest standard of excellence.

Wrought Iron and Steel.

The tensile strength of wrought iron depends not only on its quality, but also, to some extent, on the condensation imparted by working; consequently, small bars, as a rule, will be stronger per unit of sectional area than large bars. Good material of usual dimensions may be assumed to average 50,000 lbs. ultimate tensile strength, per square inch of section. The same conditions apply in structural steel, but this material will vary also according to grade or hardness. The steel used in structures will vary from 55,000 to 80,000 lbs. ultimate tensile strength; probably 65,000 lbs. per square inch of section represent the tensile strength of the steel most frequently used to resist tensile strains.

ELASTIC LIMIT AND DUCTILITY.

As iron or steel elongates or shortens under strain, the change of length is directly proportionate to the strain, and the material recovers its original length on removal of the strain, until the elastic limit is reached, when changes of length are no longer regular, and permanent set takes place, or the destruction of the material has begun.

In good material the strain at elastic limit is very nearly six-tenths of the ultimate tenacity. This is the case for strains, either of tension or compression. Thus the strain at elastic limit in good wrought iron of small sections is about 30,000 lbs. per square inch, and for steel of 65,000 lbs. tensile strength it will be about 40,000 lbs.

The ductility, under tensile strains, is usually measured by the total elongation in a given length, or by the percentage of reduction of the fractured area, or by both. Good wrought iron, when strained to rupture, should elongate about 18 per cent. on a measured length of twelve diameters, and the fractured area should be reduced about 25 per cent. of the original section. Steel of 65,000 lbs. tensile strength should similarly elongate about 22 per cent., and the fractured area should be reduced about 40 per cent. of the original section.

ELASTICITY.

The elasticity is measured by the change of length under strain below the elastic limit of the material. The elasticity of iron and steel are practically uniform, that is, each material will exhibit a uniform change of length under uniform strains below the elastic limit; but, as the elastic limit of steel is higher than that of iron, the former will elongate or shorten to a greater extent than the latter before its elasticity is injured. This property is expressed by a modulus, which for either material will average about 29,000,000 lbs. That is, if the change of length could be extended sufficiently, it would require 29,000,000 lbs. per square inch of section to double the original length under tensile strain, or to shorten the length one-half under compression.

EXPANSION BY HEAT.

Soft steel or iron will expand about $\frac{1}{150000}$ part of its length for each degree F. of elevation of temperature. For a variation in temperature of 100 degrees F., the change in length will be about one inch in 125 feet.

SPECIFIC GRAVITY.

The specific gravity of steel and iron varies according to the purity of the metal, and also to the degree of condensation imparted by the rolling process.

As a rule, the mild steel has a higher specific gravity than hard steel, and both are denser than iron. A number of tests we have made for specific gravity show rolled bars of mild steel to vary from 7.84 to 7.88, and hard steel from 7.81 to 7.85 specific gravity. Ordinary iron bars will vary from 7.6 to 7.8.

In the form of beams and large rolled sections generally, the following figures may be accepted as a fair average :

Material.	*Weight per Cubic Foot.*	*Weight per Cubic Inch.*
Mild Steel,	489.0 lbs.	.283 lb.
Hard Steel,	486.6 "	.2815 "
Iron,	478.3 "	.2768 "

Or, for the same sectional areas, the excess in weight over

iron will be, for mild steel 2.24 per cent., and for hard steel 1.7 per cent.

It is customary to assume the weight of rolled iron as 480 lbs. per cubic foot, and this is, probably, practically correct for the average material; medium steel will average 2 per cent. heavier.

On this basis we have weights in lbs. for

	Iron and Steel.
One cubic foot,	480 489.6
One cubic inch,	.278 .284
One square inch one foot long,	3⅓ 3.4
One square inch one yard long,	10 10.2

STRUCTURAL STEEL.

As a general rule, the percentage of carbon in steel determines its hardness and strength. The higher the carbon the harder the steel, the higher the tenacity and the lower the ductility will be. The following list exhibits the average physical properties of good open-hearth steel:

Percentage of Carbon.	*Tensile Strength in Pounds per Square Inch.*		*Ductility.*	
	Ultimate Tenacity.	*Elastic Limit.*	*Stretch in 8 Inches.*	*Reduction of Fractured Area.*
.10	57000	34000	28 per cent.	55 per cent.
.15	62000	37000	26 "	50 "
.20	67000	40000	24 "	45 "
.25	72000	43000	22 "	40 "
.30	77000	46000	20 "	35 "
.35	82000	49000	18 "	30 "
.40	87000	52000	16 "	25 "

The coefficient of elasticity is practically uniform for all grades, and, as previously stated, is the same as for iron, viz., 29,000,000 lbs. These figures form the average of a numerous series of tests from rolled bars, and can only serve as an approximation in single instances, when the variation from the average may be considerable. For convenient distinguishing terms, it is customary to classify steel in three grades: "mild or soft," "medium," and "hard;" and although the different grades blend into each other, so that no line of distinction exists, in a general sense the grades below .15 carbon may be considered as "soft" steel, from

.15 to .30 carbon as "medium," and above that "hard" steel. Each grade has its own advantages for the particular purpose to which it is adapted. The soft steel is well adapted for boiler plate and similar uses, where its high ductility is advantageous. The medium grades are used for general structural purposes, while harder steel is useful in cases where good wearing surfaces are desired. Mild steel has superior welding property as compared to hard steel, and will endure higher heat without injury. Steel below .10 carbon should be capable of doubling flat without fracture, after being chilled from a red heat in cold water. Steel of .15 carbon will occasionally submit to the same treatment, but will usually bend around a curve whose radius is equal to the thickness of the specimen; about 90 per cent. of specimens stand the latter bending test without fracture. As the steel becomes harder its ability to endure this bending test becomes more exceptional, and when the carbon ratio becomes .20, little over twenty-five per cent. of specimens will stand the last-described bending test. Steel having about .40 per cent. carbon will usually harden sufficiently to cut soft iron and maintain an edge.

COMPARATIVE EFFICIENCIES OF STEEL AND IRON.

For Beams.—As steel has a higher tenacity than iron, varying according to grade; when used in beams, the steel beam will sustain a greater load than the similar iron beam, without destructive stress; but as the coefficient of elasticity of both metals is identical, the deflection of both beams will be alike under equal loads. These facts indicate that for beams in which the span is small, as compared to beam depth, and the deflection does not become excessive within the limits of permissible stress, then steel beams possess a decided advantage in strength over iron beams, in proportion to the respective tenacities of the metals. If, on the contrary, the span is great as compared to depth of beam, and the usefulness of the beam is determined by its deflection, the beam of steel will possess little, if any, advantage over that of iron.

STEEL SHAFTING.

For resistance to shear or torsion, steel exceeds iron, in the ratio of the respective tenacities of the materials. Therefore when strength irrespective of stiffness is considered, use the formulæ given on page 222, substituting the shearing resistance of steel for that given for iron, viz., about three-fourths of the tensile strength. Ordinarily the utility of shafting is determined by its stiffness under working loads, rather than by a high elastic limit, and as the coefficient of elasticity is uniform for steel and iron, it becomes necessary to use the same dimensions for steel shafts as for wrought iron.

STEEL STRUTS AND COLUMNS.

Experiments on direct compression prove that the elastic limits of steel, as of iron, under stresses of tension and compression, are about equal.

Consequently for the shortest struts, where failure results from the effects of direct compression, the tensile resistances of steel and iron serve as a comparative measure of the strut resistance of the two materials.

But as the strut is increased in length, and failure results from lateral flexure before the compressive limit of elasticity is attained, then the transverse elasticity of the material becomes a factor of increasing importance in determining the strut resistance.

As in this respect steel possesses little advantage, if any, over iron, the tendency will be for struts of steel and iron as the length is increased to approximate toward equality of resistance. This equality with iron will occur first with the mildest steel, and latest with the hardest steel.

The results of many experiments we have made seem to demonstrate that this equality of strut resistance is practically attained between iron and mild steel, when the ratio of length to least radius of gyration of cross-section is about 200 to 1. In the case of the harder steels, practical equality of resistance with iron will occur at some higher but indefinite ratio of length to section.

Tables for Pencoyd Beams of Iron or Steel.

The following tables for beams give the greatest safe loads in net tons, evenly distributed, including the weight of the beam. The results are obtained by the methods described on pages 149 to 165, and correspond to extreme fibre stresses of 14,000 lbs. for iron, or 16,800 lbs. for steel, or approximately about one-half the elastic limit of the materials, presuming that very soft steel may be used.

LIMITS FOR THE SAFE LOAD.

These loads are given as the greatest safe loads, and the beams are entirely reliable for them under ordinary conditions.

As there is great diversity in published tables of safe loads for beams, everyone must judge for himself what proportion of the elastic strength of the beam will best suit his purpose.

The character of the load must be considered, and the mode of application of the same. If the load is suddenly applied, especially if accompanied by impact, the resulting dynamic stresses will not be expressed by formulæ which are derived from static consideration alone. Freedom from vibration, or excessive deflection has usually to be provided for, or the beam may be of considerable length without lateral support. In many such cases it may be necessary to take smaller loads for beams than those given in tables. In general, the following limitations of the tabulated safe loads will be proper for the specified conditions:

Character of Service.	*Greatest Safe Loads.*
Quiescent load, subject to little vibration, as in ordinary floors, etc., especially where beams are short.	As in tables.
Fluctuating loads, causing vibration, especially if the beams are long as compared to their depth.	One-fifth ($\frac{1}{5}$) less than the table.

Character of Service.	*Greatest Safe Loads.*
When loads are suddenly applied with some impact, or exposed to vibration from machinery or rapidly moving loads.	One-third ($\frac{1}{3}$) less than the table.

The beams, if of considerable length, are supposed to be braced horizontally, and it is safest to limit the application of the tabular loads to beams whose length between lateral supports does not exceed twenty times the flange width.

Our experience has been that a beam without lateral support is more stable than is commonly supposed. In an open-webbed beam, the top flange acts as a simple strut, and is liable to lateral flexure when the unsupported length is considerable. But in a solid beam the parts in tension sustain the parts in compression, and prevent the buckling which would otherwise occur.

Experiments have shown a reduction of about one-third of the normal modulus of rupture when the length of the beam becomes 80 times its flange width. But as the long beam may suffer if exposed to accidental cross strains, we recommend the greatest safe load to be reduced in such a ratio for long beams that when the length is seventy times the flange width the greatest safe loads will be reduced one-half. This will give safe loads, corresponding to given lengths, as follows :

BEAMS WITHOUT LATERAL SUPPORT.

Length of Beam.	*Proportion of Tabular Load Forming Greatest Safe Load.*
20 times flange width.	Whole tabular load.
30 " " "	$\frac{9}{10}$ " "
40 " " "	$\frac{8}{10}$ " "
50 " " "	$\frac{7}{10}$ " "
60 " " "	$\frac{6}{10}$ " "
70 " " "	$\frac{5}{10}$ " "

In the case of very short beams, unless the web is stiffened at the points of support, it will be necessary to

limit the safe load to that denoted "maximum load in tons," col. ××, pages 150 to 157, for reasons given on page 149.

DEFLECTION.

The tabular deflections are derived from the coefficients on pages 150 to 157, as described on page 149. If the load on the beam is reduced below that of the tables, the deflection will be less than that given in the tables, in the direct ratio of the loads.

The greatest safe load in the middle of the beam is exactly one-half ($\frac{1}{2}$) of the distributed load, and the deflection for the former will be eight-tenths ($\frac{8}{10}$) of the deflection corresponding to the distributed load as given in the tables. If the load is placed out of centre on the beam, it will bear the same ratio to the load at the centre that the square of half the span bears to the product of the segments of the beam formed by the position of the load.

Example.—A 15-inch No. 1 iron **I** beam, 16 feet between supports, will safely carry an evenly distributed load (by the tables) of 25.6 tons, and deflect under same .25 inches. The greatest safe load in the middle will be one-half the above, viz., 12.8 tons, and the resulting deflection $\frac{8}{10}$ of the former, or .20 inches.

If the weight is concentrated 3 feet out of centre, or 5 feet and 11 feet from the ends, then the square of half the span being 64, and the product of the segments being 55, the greatest safe load will be $\frac{12.8 \times 64}{55} = 14.9$ tons.

If a beam of above size and length is used without any lateral support, reduce the safe load in the ratio aforesaid. Thus the flange is $5\frac{9}{8}$ inches wide, and the length 33 times this; therefore the greatest safe load will be a little less than $\frac{9}{10}$ of the results in the example.

If beams are supported as described below, the greatest safe loads and corresponding deflections will bear the given ratios to the tabulated loads and deflections, for the same length and section of beams.

Character of Beam.	*Greatest Safe Load.*	*Deflection.*
Fixed at one end, with the load concentrated at the other end.	One-eighth ($\frac{1}{8}$) part of the tabular load.	Three and one-fifth ($3\frac{1}{5}$) times the tabular deflection.
Fixed at one end, with the load uniformly distributed.	One-fourth ($\frac{1}{4}$) part of the tabular load.	Two and two-fifths ($2\frac{2}{5}$) times the tabular deflection.
Rigidly fixed at both ends, with a load in the middle of beam.	Same as the tabular load.	Four-tenths ($\frac{4}{10}$) of the tabular deflection.
Rigidly fixed at both ends, with the load uniformly distributed.	One and one-half ($1\frac{1}{2}$) times the tabular load.	Three-tenths ($\frac{3}{10}$) of the tabular deflection.
Continuous beam loaded in middle.	Same as the tabular load.	Four-tenths ($\frac{4}{10}$) of the tabular deflection.
Continuous beam load uniformly distributed.	One and one-half ($1\frac{1}{2}$) times the tabular load.	Three-tenths ($\frac{3}{10}$) of the tabular deflection.

BEAMS WITH FIXED ENDS.

By beams "rigidly fixed," as denoted in the previous table, we mean that the beam must be so securely fastened at both ends, by being built into solid masonry, or so firmly attached to an adjacent structure, that the connection would not be severed if the beam was exposed to its ultimate load. In this case the beam is of the same character as if continuous over several supports, or as if consisting of two cantilevers, the space between whose ends was spanned by a separate beam.

CONTINUOUS BEAMS.

If a beam is continuous over several supports, and is equally loaded on each span, the greatest safe loads and the resulting deflections on any intermediate span will be as

given in the preceding table. But the end spans of such a beam, being only semi-continuous, must be either of a shorter span than the intermediates, or, if of the same length, the load must be diminished.

LIMIT FOR DEFLECTION.

It is considered good practice in the case of plastered ceilings, or in other circumstances where undue deflection may be prejudicial, to proportion beams so that their deflection will not exceed $\frac{1}{360}$ of an inch per foot of span, or $\frac{1}{360}$ part of the span.

On each table the figures under the dark line (and in small type) denote cases where the deflection exceeds $\frac{1}{360}$ part of the span.

The spacing or distance transversely between centres of floor beams is given in the tables as the "greatest" that should be used for the standard minimum section. If a thicker beam than the least section is used, an addition to the greatest spacing is given in the final column. This column is derived from the basis that the resistance of any rectangular section weighing 1 lb. per lineal foot is as follows the fibre stress for either metal, as in the tables.

$$\left.\begin{array}{l}\frac{\text{depth}}{20} \text{ for iron} \\ \frac{5 \times \text{depth}}{102} \text{ for steel}\end{array}\right\} = \begin{array}{l}\text{the resistance for each unit of area} \\ \text{equivalent to 1 lb. weight per lineal} \\ \text{foot.}\end{array}$$

Example.—A 12″ iron I beam, No. 4, is thickened to a weight of 50.1 lbs. per foot, and is used in a floor of 20 feet span, for a distributed load of 150 lbs. per square foot of floor. The addition in third column for each pound per foot is .14; $.14 \times 10$ (increased weight) $= 1.4$ tons, making greatest safe load 12.04 tons. The deflection remains .49 in. as in table. The tabular spacing of 7.09 ft. may be increased by correction in final column: $\frac{14 \times 10}{150} = .93 + 7.09 = 8.02$ ft. between beam centres. If this beam is loaded in the centre the greatest safe load will be one-half the foregoing, or 6.02 tons, and the deflection under this load will be $\frac{8}{10}$ lbs. of that for the greatest distributed load, or .39 in. If the load is reduced the deflection will be reduced in proportion.

15″ IRON I BEAMS.—No. 1.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.66	Flange width,	5.98
Web thickness,	.56	Web thickness,	.88
Area in square inches,	19.03	Area in square inches,	23.80
Resistance,	88.00	Resistance,	100.00
Pounds per foot,	63.43	Pounds per foot,	79.33

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	39.78	.35	.08	79.56	53.04	39.78	31.82	70.00
11	37.33	.32	.11	67.87	45.25	33.93	27.15	57.85
12	34.22	.29	.14	57.03	38.02	28.52	22.81	48.61
13	31.59	.27	.16	48.60	32.40	24.30	19.44	41.42
14	29.33	.25	.19	41.90	27.93	20.95	16.76	35.71
15	27.37	.23	.22	36.49	24.33	18.25	14.60	31.11
16	25.66	.21	.25	32.08	21.38	16.04	12.83	27.34
17	24.15	.20	.28	28.41	18.94	14.21	11.36	24.22
18	22.81	.19	.31	25.34	16.90	12.67	10.14	21.61
19	21.61	.18	.35	22.75	15.16	11.37	9.10	19.39
20	20.53	.18	.39	20.53	13.69	10.27	8.21	17.50
21	19.55	.17	.43	18.62	12.41	9.31	7.45	15.87
22	18.66	.16	.47	16.96	11.31	8.48	6.79	14.46
23	17.85	.15	.51	15.52	10.35	7.76	6.21	13.23
24	17.11	.15	.56	14.26	9.51	7.13	5.70	12.15
25	16.42	.14	.60	13.14	8.76	6.57	5.25	11.20
26	15.79	.14	.65	12.15	8.10	6.07	4.86	10.36
27	15.21	.13	.70	11.27	7.51	5.63	4.51	9.60
28	14.66	.13	.75	10.47	6.98	5.24	4.19	8.93
29	14.16	.12	.81	9.77	6.51	4.88	3.91	8.32
30	13.69	.12	.87	9.13	6.08	4.56	3.65	7.78
31	13.25	.11	.93	8.55	5.70	4.27	3.42	7.28
32	12.83	.11	.99	8.02	5.35	4.01	3.21	6.84
33	12.44	.11	1.05	7.54	5.03	3.77	3.02	6.43

15″ IRON I BEAMS.—No. 2.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.13	Flange width,	5.38
Web thickness,	.44	Web thickness,	.69
Area in square inches,	14.80	Area in square inches,	18.59
Resistance,	70.96	Resistance,	80.33
Pounds per foot,	49.33	Pounds per foot,	61.96

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Load as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	26.03	.35	.08	52.06	34.71	26.03	20.82	70.00
11	26.03	.32	.11	47.33	31.55	23.66	18.93	57.85
12	26.03	.29	.14	43.38	28.92	21.69	17.35	48.61
13	25.47	.27	.16	39.18	26.12	19.59	15.67	41.42
14	23.65	.25	.19	33.79	22.52	16.89	13.51	35.71
15	22.08	.23	.22	29.44	19.63	14.72	11.78	31.11
16	20.70	.21	.25	25.88	17.25	12.94	10.35	27.34
17	19.48	.20	.28	22.92	15.28	11.46	9.17	24.22
18	18.40	.19	.31	20.44	13.63	10.22	8.18	21.61
19	17.43	.18	.35	18.35	12.23	9.17	7.34	19.39
20	16.56	.18	.39	16.56	11.04	8.28	6.62	17.50
21	15.77	.17	.43	15.02	10.01	7.51	6.01	15.87
22	15.05	.16	.47	13.68	9.12	6.84	5.47	14.46
23	14.40	.15	.51	12.52	8.35	6.26	5.01	13.23
24	13.80	.15	.56	11.50	7.67	5.75	4.60	12.15
25	13.25	.14	.60	10.60	7.07	5.30	4.24	11.20
26	12.74	.14	.65	9.80	6.53	4.90	3.92	10.36
27	12.26	.13	.70	9.08	6.05	4.54	3.63	9.60
28	11.83	.13	.75	8.45	5.63	4.23	3.38	8.93
29	11.42	.12	.81	7.88	5.25	3.94	3.15	8.32
30	11.04	.12	.87	7.36	4.91	3.68	2.94	7.78
31	10.68	.11	.93	6.89	4.59	3.45	2.76	7.28
32	10.35	.11	.99	6.47	4.31	3.23	2.59	6.84
33	10.03	.11	1.05	6.08	4.05	3.04	2.43	6.43

12″ IRON I BEAMS.—No. 3.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.5	Flange width,	5.65
Web thickness,	.65	Web thickness,	.80
Area in square inches,	17.12	Area in square inches,	18.92
Resistance,	62.55	Resistance,	66.15
Pounds per foot,	57.06	Pounds per foot,	63.06

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	29.19	.28	.12	58.38	38.92	29.19	23.35	56.00
11	26.54	.25	.15	48.25	32.17	24.13	19.30	46.28
12	24.33	.23	.17	40.55	27.03	20.28	16.22	38.89
13	22.45	.21	.20	34.54	23.03	17.27	13.82	33.14
14	20.85	.20	.24	29.79	19.86	14.89	11.91	28.57
15	19.46	.19	.27	25.95	17.30	12.97	10.38	24.89
16	18.24	.18	.31	22.80	15.20	11.40	9.12	21.88
17	17.17	.17	.35	20.20	13.47	10.10	8.08	19.38
18	16.22	.16	.39	18.02	12.01	9.01	7.21	17.28
19	15.36	.15	.44	16.17	10.78	8.08	6.47	15.51
20	14.60	.14	.49	14.60	9.73	7.30	5.84	14.00
21	13.90	.13	.53	13.24	8.83	6.62	5.30	12.70
22	13.27	.13	.59	12.06	8.04	6.03	4.83	11.57
23	12.69	.12	.64	11.03	7.36	5.52	4.41	10.59
24	12.16	.12	.70	10.13	6.76	5.07	4.05	9.72
25	11.68	.11	.76	9.34	6.23	4.67	3.74	8.96
26	11.23	.11	.82	8.64	5.76	4.32	3.46	8.28
27	10.81	.10	.88	8.01	5.34	4.01	3.20	7.68
28	10.43	.10	.95	7.45	4.97	3.73	2.98	7.14
29	10.07	.10	1.02	6.94	4.63	3.47	2.78	6.66
30	9.73	.09	1.09	6.49	4.32	3.24	2.59	6.22
31	9.42	.09	1.16	6.08	4.05	3.04	2.43	5.83
32	9.12	.09	1.25	5.70	3.80	2.85	2.28	5.47
33	8.85	.08	1.34	5.36	3.58	2.68	2.15	5.14

12″ IRON I BEAMS.—No. 4.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.79	Flange width,	5.02
Web thickness,	.45	Web thickness,	.68
Area in square inches,	12.03	Area in square inches,	14.76
Resistance,	45.60	Resistance,	51.12
Pounds per foot,	40.10	Pounds per foot,	49.20

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	21.28	.28	.12	42.56	28.37	21.28	17.02	56.00
11	19.35	.25	.15	35.18	23.45	17.59	14.07	46.28
12	17.73	.23	.17	29.55	19.70	14.78	11.82	38.89
13	16.37	.21	.20	25.18	16.79	12.59	10.07	33.14
14	15.20	.20	.24	21.71	14.48	10.86	8.69	28.57
15	14.19	.19	.27	18.92	12.61	9.46	7.57	24.89
16	13.30	.18	.31	16.62	11.08	8.31	6.65	21.88
17	12.52	.17	.35	14.73	9.82	7.36	5.89	19.38
18	11.82	.16	.39	13.13	8.76	6.57	5.25	17.28
19	11.20	.15	.44	11.79	7.86	5.89	4.72	15.51
20	10.64	.14	.49	10.64	7.09	5.32	4.26	14.00
21	10.13	.13	.53	9.65	6.43	4.82	3.86	12.70
22	9.67	.13	.59	8.79	5.86	4.40	3.52	11.57
23	9.25	.12	.64	8.04	5.36	4.02	3.22	10.59
24	8.87	.12	.70	7.39	4.93	3.70	2.96	9.72
25	8.51	.11	.76	6.81	4.54	3.40	2.72	8.96
26	8.18	.11	.82	6.29	4.19	3.15	2.52	8.28
27	7.88	.10	.88	5.84	3.89	2.92	2.33	7.68
28	7.60	.10	.95	5.43	3.62	2.71	2.17	7.14
29	7.34	.10	1.02	5.06	3.37	2.53	2.02	6.66
30	7.09	.09	1.09	4.73	3.15	2.36	1.89	6.22
31	6 86	.09	1.16	4.43	2.95	2.21	1.77	5.83
32	6.65	.09	1.25	4.16	2.77	2.08	1.66	5.47
33	6.45	.08	1.34	3.91	2.61	1.95	1.56	5.14

10½″ IRON I BEAMS.—No. 5.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.25	Flange width,	5.50
Web thickness,	.47	Web thickness,	.72
Area in square inches,	13.53	Area in square inches,	16.16
Resistance,	46.21	Resistance,	50.80
Pounds per foot,	45.10	Pounds per foot,	53.86

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds. per Sq. Foot.*	
10	21.57	.24	.14	43.14	28.76	21.57	17.26	49.00
11	19.60	.22	.17	35.64	23.76	17.82	14.25	40.50
12	17.97	.20	.20	29.95	19.97	14.98	11.98	34.03
13	16.59	.18	.24	25.52	17.02	12.76	10.21	28.99
14	15.40	.17	.27	22.00	14.67	11.00	8.80	25.00
15	14.38	.16	.31	19.17	12.78	9.59	7.67	21.78
16	13.48	.15	.36	16.85	11.23	8.43	6.74	19.14
17	12.69	.14	.40	14.93	9.95	7.46	5.97	16.95
18	11.98	.14	.45	13.31	8.87	6.66	5.32	15.12
19	11.35	.13	.51	11.95	7.96	5.97	4.78	13.57
20	10.78	.12	.56	10.78	7.19	5.39	4.31	12.25
21	10.27	.12	.62	9.78	6.52	4.89	3.91	11.11
22	9.80	.11	.68	8.91	5.94	4.45	3.56	10.12
23	9.38	.11	.74	8.16	5.44	4.08	3.26	9.26
24	8.99	.10	.81	7.49	4.99	3.75	3.00	8.51
25	8.63	.10	.88	6.90	4.60	3.45	2.76	7.84
26	8.29	.09	.95	6.38	4.25	3.19	2 55	7.25
27	7.99	.09	1.02	5.92	3.95	2.96	2.37	6.72
28	7.70	.09	1.10	5.50	3.67	2.75	2.20	6.25
29	7.44	.08	1.18	5.13	3.42	2.57	2.05	5.83
30	7.19	.08	1.26	4.79	3.20	2.40	1.92	5.44
31	6.96	.08	1.35	4.49	2.99	2.25	1.80	5.10
32	6.74	.08	1.43	4.21	2.81	2.11	1.69	4.79
33	6.54	.07	1.53	3 96	2.64	1.98	1.59	4.50

$10\frac{1}{2}''$ IRON I BEAMS.—No. $5\frac{1}{2}$.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.87	Flange width,	5.12
Web thickness,	.41	Web thickness,	.66
Area in square inches,	10.96	Area in square inches,	13.58
Resistance,	37.52	Resistance,	42.11
Pounds per foot,	36.53	Pounds per foot,	45.26

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds. per Sq. Foot.*	
10	17.51	.24	.14	35.02	23.35	17.51	14.01	49.00
11	15.92	.22	.17	28.95	19.30	14.47	11.58	40.50
12	14.59	.20	.20	24.32	16.21	12.16	9.73	34.03
13	13.47	.18	.24	20.72	13.82	10.36	8.29	28.99
14	12.51	.17	.27	17.87	11.91	8.94	7.15	25.00
15	11.67	.16	.31	15.56	10.37	7.78	6.22	21.78
16	10.94	.15	.36	13.68	9.12	6.84	5.47	19.14
17	10.30	.14	.40	12.12	8.08	6.06	4.85	16.95
18	9.73	.14	.45	10.81	7.21	5.41	4.32	15.12
19	9.22	.13	.51	9.71	6.47	4.85	3.88	13.57
20	8.75	.12	.56	8.75	5.83	4.38	3.50	12.25
21	8.34	.12	.62	7.94	5.30	3.97	3.18	11.11
22	7.96	.11	.68	7.24	4.82	3.62	2.89	10.12
23	7.61	.11	.74	6.62	4.41	3.31	2.65	9.26
24	7.30	.10	.81	6.08	4.06	3.04	2.43	8.51
25	7.00	.10	.88	5.60	3.73	2.80	2.24	7.84
26	6.73	.09	.95	5.18	3.45	2.59	2.07	7.25
27	6.48	.09	1.02	4.80	3.20	2.40	1.92	6.72
28	6.25	.09	1.10	4.46	2.98	2.23	1.79	6.25
29	6.04	.08	1.18	4.17	2.78	2.08	1.67	5.83
30	5.84	.08	1.26	3.89	2.60	1.95	1.56	5.44
31	5.65	.08	1.35	3.65	2.43	1.82	1.46	5.10
32	5.47	.08	1.43	3.42	2.28	1.71	1.37	4.79
33	5.31	.07	1.53	3.22	2.15	1.61	1.29	4.50

10½″ IRON I BEAMS.—No. 6.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.50	Flange width,	4.68
Web thickness,	.35	Web thickness,	.53
Area in square inches,	9.00	Area in square inches,	10.89
Resistance,	31.15	Resistance,	34.46
Pounds per foot,	30.00	Pounds per foot,	36.30

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds. per Sq. Foot.*	
10	14.54	.24	.14	29.08	19.39	14.54	11.63	49.00
11	13.21	.22	.17	24.02	16.01	12.01	9.61	40.50
12	12.11	.20	.20	20.18	13.46	10.09	8.07	34.03
13	11.18	.18	.24	17.20	11.47	8.60	6.88	28.99
14	10.38	.17	.27	14.83	9.89	7.41	5.93	25.00
15	9.69	.16	.31	12.92	8.61	6.46	5.17	21.78
16	9.09	.15	.36	11.36	7.58	5.68	4.55	19.14
17	8.55	.14	.40	10.06	6.71	5.03	4.02	16.95
18	8.08	.14	.45	8.98	5.99	4.49	3.59	15.12
19	7.65	.13	.51	8.05	5.37	4.03	3.22	13.57
20	7.27	.12	.56	7.27	4.85	3.64	2.91	12.25
21	6.92	.12	.62	6.59	4.39	3.30	2.64	11.11
22	6.61	.11	.68	6.01	4.01	3.00	2.40	10.12
23	6.32	.11	.74	5.50	3.66	2.75	2.20	9.26
24	6.06	.10	.81	5.05	3.37	2.53	2.02	8.51
25	5.81	.10	.88	4.65	3.10	2.32	1.86	7.84
26	5.59	.09	.95	4.30	2.87	2.15	1.72	7.25
27	5.38	.09	1.02	3.99	2.66	1.99	1.59	6.72
28	5.19	.09	1.10	3.71	2.47	1.85	1.48	6.25
29	5.01	.08	1.18	3.46	2.30	1.73	1.38	5.83
30	4.85	.08	1.26	3.23	2.16	1.62	1.29	5.44
31	4.69	.08	1.35	3.03	2.02	1.51	1.21	5.10
32	4.54	.08	1.43	2.84	1.89	1.42	1.14	4.79
33	4.40	.07	1.53	2.67	1.78	1.33	1.07	4.50

10″ IRON I BEAMS.—No. 7.

LEAST SECTION.

Flange width, ... 4.63
Web thickness, ...50
Area in square inches, ... 11.25
Resistance, ... 34.87
Pounds per foot, ... 37.50

GREATEST SECTION.

Flange width, ... 4.88
Web thickness, ...75
Area in square inches, ... 13.75
Resistance, ... 39.04
Pounds per foot, ... 45.83

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	16.27	.23	.15	32.54	21.69	16.27	13.02	46.67
11	14.79	.21	.18	26.89	17.93	13.45	10.76	38.57
12	13.56	.19	.21	22.60	15.07	11.30	9.04	32.41
13	12.52	.18	.25	19.26	12.84	9.63	7.70	27.61
14	11.62	.17	.29	16.60	11.07	8.30	6.64	23.81
15	10.85	.16	.33	14.47	9.64	7.23	5.79	20.74
16	10.17	.15	.38	12.71	8.48	6.36	5.09	18.23
17	9.57	.14	.42	11.26	7.51	5.63	4.50	16.15
18	9.04	.13	.48	10.04	6.70	5.02	4.02	14.40
19	8.56	.12	.53	9.01	6.01	4.51	3.60	12.93
20	8.14	.12	.59	8.14	5.43	4.07	3.26	11.67
21	7.75	.11	.65	7.38	4.92	3.69	2.95	10.58
22	7.40	.11	.71	6.73	4.48	3.36	2.69	9.64
23	7.07	.10	.78	6.15	4.10	3.07	2.46	8.82
24	6.78	.10	.84	5.65	3.77	2.83	2.26	8.10
25	6.51	.09	.92	5.21	3.47	2.60	2.08	7.47
26	6.26	.09	.99	4.82	3.21	2.41	1.93	6.90
27	6.03	.09	1.07	4.47	2.98	2.23	1.79	6.40
28	5.81	.08	1.15	4.15	2.77	2.08	1.66	5.95
29	5.61	.08	1.23	3.87	2.58	1.93	1.55	5.55
30	5.42	.08	1.32	3.61	2.41	1.81	1.45	5.19
31	5.25	.08	1.41	3.39	2.26	1.69	1.35	4.86
32	5.09	.07	1.50	3.18	2.12	1.59	1.27	4.56
33	4.93	.07	1.60	2.99	1.99	1.49	1.19	4.29

10″ IRON I BEAMS.—No. 8.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.38	Flange width,	4.53
Web thickness,	.35	Web thickness,	.50
Area in square inches,	9.14	Area in square inches,	10.64
Resistance,	30.23	Resistance,	32.72
Pounds per foot,	30.46	Pounds per foot,	35.46

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
10	14.11	.23	.15	28.22	18.81	14.11	11.29	46.67
11	12.82	.21	.18	23.31	15.54	11.65	9.32	38.57
12	11.76	.19	.21	19.60	13.07	9.80	7.84	32.41
13	10.85	.18	.25	16.69	11.13	8.35	6.68	27.61
14	10.08	.17	.29	14.40	9.60	7.20	5.76	23.81
15	9.40	.16	.33	12.53	8.36	6.27	5.01	20.74
16	8.82	.15	.38	11.03	7.35	5.51	4.41	18.23
17	8.30	.14	.42	9.76	6.51	4.88	3.91	16.15
18	7.84	.13	.48	8.71	5.81	4.36	3.48	14.40
19	7.42	.12	.53	7.81	5.21	3.91	3.12	12.93
20	7.05	.12	.59	7.05	4.70	3.53	2.82	11.67
21	6.72	.11	.65	6.40	4.27	3.20	2.56	10.58
22	6.41	.11	.71	5.83	3.88	2.91	2.33	9.64
23	6.13	.10	.78	5.33	3.55	2.67	2.13	8.82
24	5.87	.10	.84	4.89	3.26	2.45	1.96	8.10
25	5.64	.09	.92	4.51	3.01	2.26	1.80	7.47
26	5.43	.09	.99	4.18	2.78	2.09	1.67	6.90
27	5.22	.09	1.07	3.87	2.58	1.93	1.55	6.40
28	5.04	.08	1.15	3.60	2.40	1.80	1.44	5.95
29	4.86	.08	1.23	3.35	2.23	1.68	1.34	5.55
30	4.70	.08	1.32	3.13	2.09	1.57	1.25	5.19
31	4.55	.08	1.41	2.94	1.96	1.47	1.17	4.86
32	4.41	.07	1.50	2.76	1.84	1.38	1.10	4.56
33	4.27	.07	1.60	2.59	1.73	1.29	1.04	4.29

9″ IRON I BEAMS.—No. 9.

LEAST SECTION.

Flange width,	4.75
Web thickness,	.41
Area in square inches,	9.28
Resistance,	27.10
Pounds per foot,	30.93

GREATEST SECTION.

Flange width,	4.94
Web thickness,	.60
Area in square inches,	10.99
Resistance,	29.66
Pounds per foot,	36.63

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Load as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
8	15.81	.26	.10	39.53	26.35	19.76	15.81	65.63
9	14.05	.23	.13	31.22	20.81	15.61	12.49	51.86
10	12.65	.21	.16	25.30	16.87	12.65	10.12	42.00
11	11.50	.19	.20	20.91	13.94	10.45	8.36	34.71
12	10.54	.17	.23	17.57	11.71	8.78	7.03	29.17
13	9.73	.16	.28	14.97	9.88	7.48	5.99	24.85
14	9.03	.15	.32	12.90	8.60	6.45	5.16	21.43
15	8.43	.14	.37	11.24	7.49	5.62	4.50	18.67
16	7.90	.13	.42	9.88	6.58	4.94	3.95	16.41
17	7.44	.12	.47	8.75	5.84	4.38	3.50	14.53
18	7.03	.12	.53	7.81	5.21	3.91	3.12	12.96
19	6.66	.11	.59	7.01	4.67	3.51	2.80	11.63
20	6.32	.10	.65	6.32	4.21	3.16	2.53	10.50
21	6.02	.10	.72	5.73	3.82	2.87	2.29	9.52
22	5.75	.09	.79	5.23	3.48	2.61	2.09	8.68
23	5.50	.09	.86	4.78	3.19	2.39	1.91	7.94
24	5.27	.09	.94	4.39	2.93	2.20	1.76	7.29
25	5.06	.08	1.02	4.05	2.70	2.02	1.62	6.72
26	4.86	.08	1.10	3.74	2.49	1.87	1.50	6.21
27	4.68	.08	1.19	3.47	2.31	1.73	1.39	5.76
28	4.52	.07	1.28	3.23	2.15	1.61	1.29	5.36
29	4.36	.07	1.37	3.01	2.00	1.50	1.20	4.99
30	4.22	.07	1.47	2.81	1.87	1.41	1.12	4.67
31	4.08	.06	1.57	2.63	1.75	1.32	1.05	4.37

9″ IRON I BEAMS.—No. 10.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.25	Flange width,	4.44
Web thickness,	.31	Web thickness,	.50
Area in square inches,	7.18	Area in square inches,	8.89
Resistance,	21.48	Resistance,	24.05
Pounds per foot,	23.93	Pounds per foot,	29.63

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
8	12.50	.26	.10	31.25	20.83	15.63	12.50	65.63
9	11.14	.23	.13	24.76	16.50	12.38	9.90	51.86
10	10.02	.21	.16	20.04	13.36	10.02	8.02	42.00
11	9.11	.19	.20	16.56	11.04	8.28	6.63	34.71
12	8.35	.17	.23	13.92	9.28	6.96	5.57	29.17
13	7.71	.16	.28	11.86	7.91	5.93	4.74	24.85
14	7.16	.15	.32	10.23	6.82	5.11	4.09	21.43
15	6.68	.14	.37	8.91	5.94	4.45	3.56	18.67
16	6.27	.13	.42	7.84	5.23	3.92	3.14	16.41
17	5.90	.12	.47	6.94	4.63	3.47	2.78	14.53
18	5.57	.12	.53	6.19	4.13	3.09	2.48	12.96
19	5.28	.11	.59	5.56	3.71	2.78	2.22	11.63
20	5.01	.10	.65	5.01	3.34	2.51	2.00	10.50
21	4.77	.10	.72	4.54	3.03	2.27	1.82	9.52
22	4.56	.09	.79	4.15	2.76	2.07	1.66	8.68
23	4.36	.09	.86	3.79	2.53	1.89	1.52	7.94
24	4.18	.09	.94	3.48	2.32	1.74	1.39	7.29
25	4.01	.08	1.02	3.21	2.14	1.60	1.28	6.72
26	3.86	.08	1.10	2.97	1.98	1.48	1.19	6.21
27	3.71	.08	1.19	2.75	1.83	1.37	1.10	5.76
28	3.58	.07	1.28	2.56	1.70	1.28	1.02	5.36
29	3.46	.07	1.37	2.39	1.59	1.19	0.95	4.99
30	3.34	.07	1.47	2.23	1.48	1.11	0.89	4.67
31	3.23	.06	1.57	2.08	1.39	1.04	0.83	4.37

8″ IRON I BEAMS.—No. 11.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.33	Flange width,	4.57
Web thickness,	.41	Web thickness,	.60
Area in square inches,	8.26	Area in square inches,	9.78
Resistance,	21.20	Resistance,	23.23
Pounds per foot,	27.53	Pounds per foot,	32.60

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	16.49	.31	.07	54.97	36.64	27.48	21.99	103.70
7	14.13	.27	.09	40.37	26.91	20.18	16.15	76.18
8	12.37	.23	.12	30.93	20.62	15.46	12.37	58.33
9	10.99	.21	.15	24.42	16.28	12.21	9.77	46.09
10	9.89	.19	.18	19.78	13.19	9.89	7.91	37.33
11	8.99	.17	.22	16.35	10.90	8.17	6.54	30.85
12	8.24	.16	.26	13.73	9.16	6.87	5.49	25.92
13	7.61	.14	.31	11.71	7.81	5.85	4.68	22.09
14	7.07	.13	.36	10.10	6.73	5.05	4.04	19.05
15	6.60	.12	.41	8.80	5.87	4.40	3.52	16.59
16	6.18	.12	.47	7.73	5.15	3.86	3.09	14.58
17	5.82	.11	.53	6.85	4.56	3.42	2.74	12.92
18	5.50	.10	.59	6.11	4.07	3.06	2.44	11.52
19	5.21	.10	.66	5.48	3.66	2.74	2.19	10.34
20	4.95	.09	.73	4.95	3.30	2.48	1.98	9.33
21	4.71	.09	.81	4.49	2.99	2.24	1.79	8.46
22	4.50	.08	.89	4.09	2.73	2.05	1.64	7.71
23	4.30	.08	.97	3.74	2.49	1.87	1.50	7.06
24	4.12	.08	1.06	3.43	2.29	1.72	1.37	6.48
25	3.96	.07	1.15	3.17	2.11	1.58	1.27	5.97
26	3.80	.07	1.24	2.92	1.95	1.46	1.17	5.52
27	3.66	.07	1.34	2.71	1.81	1.36	1.08	5.12
28	3.53	.07	1.44	2.52	1.68	1.26	1.01	4.76
29	3.41	.06	1.54	2.35	1.57	1.18	0.94	4.44

8″ IRON I BEAMS.—No. 12.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.00	Flange width,	4.20
Web thickness,	.30	Web thickness,	.50
Area in square inches,	6.24	Area in square inches,	7.84
Resistance,	16.71	Resistance,	18.84
Pounds per foot,	20.80	Pounds per foot,	26.13

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
6	11.40	.31	.07	38.00	25.33	19.00	15.20	103.70
7	11.14	.27	.09	31.83	21.22	15.91	12.73	76.18
8	9.75	.23	.12	24.38	16.25	12.19	9.75	58.33
9	8.66	.21	.15	19.24	12.83	9.62	7.70	46.09
10	7.80	.19	.18	15.60	10.40	7.80	6.24	37.33
11	7.09	.17	.22	12.89	8.59	6.45	5.16	30.85
12	6.50	.16	.26	10.83	7.22	5.42	4.33	25.92
13	6.00	.14	.31	9.23	6.15	4.62	3.61	22.09
14	5.57	.13	.36	7.96	5.30	3.98	3.18	19.05
15	5.20	.12	.41	6.93	4.62	3.47	2.77	16.59
16	4.87	.12	.47	6.09	4.06	3.04	2.44	14.58
17	4.59	.11	.53	5.40	3.60	2.70	2.16	12.92
18	4.33	.10	.59	4.81	3.21	2.41	1.92	11.52
19	4.10	.10	.66	4.32	2.88	2.16	1.73	10.34
20	3.90	.09	.73	3.90	2.60	1.95	1.56	9.33
21	3.71	.09	.81	3.53	2.36	1.77	1.41	8.46
22	3.54	.08	.89	3.22	2.15	1.61	1.29	7.71
23	3.39	.08	.97	2.95	1.97	1.47	1.18	7.06
24	3.25	.08	1.06	2.71	1.81	1.35	1.08	6.48
25	3.12	.07	1.15	2.50	1.66	1.25	1.00	5.97
26	3.00	.07	1.24	2.31	1.54	1.15	0.92	5.52
27	2.89	.07	1.34	2.14	1.43	1.07	0.86	5.12
28	2.79	.07	1.44	1.99	1.33	1.00	0.80	4.76
29	2.69	.06	1.54	1.86	1.24	0.93	0.74	4.44

7″ IRON I BEAMS.—No. 13.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.81	Flange width,	3.87
Web thickness,	.44	Web thickness,	.50
Area in square inches,	6.68	Area in square inches,	7.10
Resistance,	14.40	Resistance,	14.89
Pounds per foot,	22.26	Pounds per foot,	23.67

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	11.20	.27	.08	37.33	24.89	18.67	14.93	90.75
7	9.60	.23	.10	27.43	18.29	13.71	10.97	66.67
8	8.40	.20	.13	21.00	14.00	10.50	8.40	51.05
9	7.47	.18	.17	16.60	11.07	8.30	6.64	40.33
10	6.72	.16	.21	13.44	8.96	6.72	5.38	32.67
11	6.11	.15	.25	11.11	7.41	5.55	4.44	27.00
12	5.60	.14	.30	9.33	6.22	4.67	3.73	22.69
13	5.17	.13	.35	7.95	5.30	3.98	3.18	19.33
14	4.80	.12	.41	6.86	4.57	3.43	2.74	16.67
15	4.48	.11	.47	5.97	3.98	2.99	2.39	14.52
16	4.20	.10	.53	5.25	3.50	2.63	2.10	12.76
17	3.95	.10	.60	4.65	3.10	2.32	1.86	11.30
18	3.73	.09	.68	4.14	2.76	2.07	1.66	10.08
19	3.54	.09	.76	3.73	2.48	1.86	1.49	9.05
20	3.36	.08	.84	3.36	2.24	1.68	1.34	8.17
21	3.20	.08	.92	3.05	2.03	1.52	1.22	7.41
22	3.05	.07	1.01	2.77	1.85	1.39	1.11	6.75
23	2.92	.07	1.10	2.54	1.69	1.27	1.02	6.18
24	2.80	.07	1.20	2.33	1.56	1.17	0.93	5.67
25	2.69	.07	1.30	2.15	1.43	1.08	0.86	5.23
26	2.58	.06	1.41	1.98	1.32	0.99	0.79	4.83
27	2.49	.06	1.52	1.84	1.23	0.92	0.74	4.48
28	2.40	.06	1.64	1.71	1.14	0.86	0.69	4.17
29	2.32	.06	1.76	1.60	1.07	0.80	0.64	3.88

7″ IRON I BEAMS.—No. 14.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.61	Flange width,	3.81
Web thickness,	.24	Web thickness,	.41
Area in square inches,	5.26	Area in square inches,	6.66
Resistance,	12.74	Resistance,	14.37
Pounds per foot,	17.53	Pounds per foot,	22.21

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq Foot.*	
6	7.50	.27	.08	25.00	16.67	12.50	10.00	90.75
7	7.50	.23	.10	21.43	14.29	10.71	8.57	66.67
8	7.43	.20	.13	18.58	12.38	9.29	7.43	51.05
9	6.61	.18	.17	14.69	9.79	7.34	5.88	40.33
10	5.95	.16	.21	11.90	7.93	5.95	4.76	32.67
11	5.40	.15	.25	9.82	6.55	4.91	3.93	27.00
12	4.95	.14	.30	8.25	5.50	4.13	3.30	22.69
13	4.57	.13	.35	7.03	4.69	3.52	2.81	19.33
14	4.25	.12	.41	6.07	4.05	3.04	2.43	16.67
15	3.96	.11	.47	5.28	3.52	2.64	2.11	14.52
16	3.72	.10	.53	4.65	3.10	2.33	1.86	12.76
17	3.50	.10	.60	4.12	2.75	2.06	1.65	11.30
18	3.30	.09	.68	3.67	2.44	1.83	1.47	10.08
19	3.13	.09	.76	3.29	2.20	1.65	1.32	9.05
20	2.97	.08	.84	2.97	1.98	1.49	1.19	8.17
21	2.83	.08	.92	2.70	1.80	1.35	1.08	7.41
22	2.70	.07	1.01	2.45	1.64	1.23	0.98	6.75
23	2.58	.07	1.10	2.24	1.50	1.12	0.90	6.18
24	2.48	.07	1.20	2.07	1.38	1.03	0.83	5.67
25	2.38	.07	1.30	1.90	1.27	0.95	0.76	5.23
26	2.29	.06	1.41	1.76	1.17	0.88	0.70	4.83
27	2.20	.06	1.52	1.63	1.09	0.81	0.65	4.48
28	2.12	.06	1.64	1.51	1.01	0.76	0.60	4.17
29	2.05	.06	1.76	1.41	0.94	0.71	0.57	3.88

6″ IRON I BEAMS.—No. 23.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.25	Flange width,	5.50
Web thickness,	.63	Web thickness,	.88
Area in square inches,	11.79	Area in square inches,	13.29
Resistance,	21.36	Resistance,	22.86
Pounds per foot,	39.30	Pounds per foot,	44.30

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	16.61	.23	.09	55.37	36.91	27.68	22.15	77.78
7	14.24	.20	.02	40.69	27.12	20.34	16.27	57.14
8	12.46	.18	.16	31.15	20.77	15.58	12.46	43.75
9	11.08	.16	.20	24.62	16.41	12.31	9.85	34.57
10	9.97	.14	.24	19.94	13.29	9.97	7.98	28.00
11	9.06	.13	.29	16.47	10.98	8.24	6.59	23.14
12	8.31	.12	.35	13.85	9.23	6.93	5.54	19.44
13	7.67	.11	.41	11.80	7.87	5.90	4.72	16.57
14	7.12	.10	.48	10.17	6.78	5.09	4.07	14.29
15	6.65	.09	.55	8.87	5.91	4.43	3.55	12.44
16	6.23	.09	.63	7.79	5.19	3.89	3.12	10.94
17	5.86	.08	.71	6.89	4.60	3.45	2.76	9.69
18	5.54	.08	.79	6.16	4.10	3.08	2.46	8.64
19	5.25	.07	.88	5.53	3.68	2.76	2.21	7.76
20	4.98	.07	.97	4.98	3.32	2.49	1.99	7.00
21	4.75	.07	1.07	4.52	3.02	2.26	1.81	6.35
22	4.53	.06	1.18	4.12	2.75	2.06	1.65	5.79
23	4.33	.06	1.29	3.77	2.51	1.88	1.51	5.29
24	4.15	.06	1.40	3.46	2.31	1.73	1.38	4.86
25	3.99	.06	1.52	3.19	2.13	1.60	1.28	4.48
26	3.83	.05	1.65	2.95	1.96	1.47	1.18	4.14
27	3.69	.05	1.78	2.73	1.82	1.37	1.09	3.84
28	3.56	.05	1.91	2.54	1.70	1.27	1.02	3.57
29	3.44	.05	2.06	2.37	1.58	1.19	0.95	3.33

6″ IRON I BEAMS.—No. 24.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.88	Flange width,	5.13
Web thickness,	.50	Web thickness,	.75
Area in square inches,	9.27	Area in square inches,	10.77
Resistance,	17.51	Resistance,	19.01
Pounds per foot,	30.90	Pounds per foot,	35.90

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq Foot.*	
6	13.62	.23	.09	45.40	30.27	22.70	18.16	77.78
7	11.67	.20	.12	33.34	22.23	16.67	13.34	57.14
8	10.21	.18	.16	25.53	17.02	12.76	10.21	43.75
9	9.08	.16	.20	20.18	13.45	10.09	8.07	34.57
10	8.17	.14	.24	16.34	10.89	8.17	6.54	28.00
11	7.43	.13	.29	13.51	9.01	6.75	5.40	23.14
12	6.81	.12	.35	11.35	7.57	5.68	4.54	19.44
13	6.29	.11	.41	9.68	6.45	4.84	3.87	16.57
14	5.84	.10	.48	8.34	5.56	4.17	3.34	14.29
15	5.45	.09	.55	7.27	4.84	3.63	2.91	12.44
16	5.11	.08	.63	6.39	4.26	3.19	2.56	10.94
17	4.81	.08	.71	5.66	3.77	2.83	2.26	9.69
18	4.54	.08	.79	5.04	3.36	2.52	2.02	8.64
19	4.30	.07	.88	4.53	3.02	2.26	1.81	7.76
20	4.09	.07	.97	4.09	2.73	2.05	1.64	7.00
21	3.89	.07	1.07	3.70	2.47	1.85	1.48	6.35
22	3.71	.06	1.18	3.37	2.25	1.69	1.35	5.79
23	3.55	.06	1.29	3.09	2.06	1.54	1.23	5.29
24	3.40	.06	1.40	2.83	1.89	1.42	1.13	4.86
25	3.27	.06	1.52	2.62	1.74	1.31	1.05	4.48
26	3.14	.05	1.65	2.42	1.61	1.21	0.97	4.14
27	3.03	.05	1.78	2.24	1.50	1.12	0.90	3.84
28	2.92	.05	1.91	2.09	1.39	1.04	0.83	3.57
29	2.82	.05	2.06	1.94	1.30	0.97	0.78	3.33

6″ IRON I BEAMS.—No. 15.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.84	Flange width,	4.19
Web thickness,	.28	Web thickness,	.63
Area in square inches,	5.65	Area in square inches,	7.75
Resistance,	11.41	Resistance,	13.51
Pounds per foot,	18.83	Pounds per foot,	25.83

Greatest safe load in net tons evenly distributed, including beam itself.

For a load in middle of beam, allow one-half of the tabular load.

Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	8.88	.23	.09	29.60	19.73	14.80	11.84	77.78
7	7.61	.20	.12	21.74	14.50	10.87	8.70	57.14
8	6.66	.18	.16	16.65	11.10	8.33	6.66	43.75
9	5.92	.16	.20	13.16	8.77	6.58	5.26	34.57
10	5.33	.14	.24	10.66	7.11	5.33	4.26	28.00
11	4.84	.13	.29	8.80	5.87	4.40	3.52	23.14
12	4.44	.12	.35	7.40	4.93	3.70	2.96	19.44
13	4.10	.11	.41	6.31	4.21	3.15	2.52	16.57
14	3.80	.10	.48	5.43	3.62	2.71	2.17	14.29
15	3.55	.09	.55	4.73	3.16	2.37	1.89	12.44
16	3.33	.09	.63	4.16	2.78	2.08	1.67	10.94
17	3.13	.08	.71	3.68	2.45	1.84	1.47	9.69
18	2.96	.08	.79	3.29	2.19	1.64	1.32	8.64
19	2.80	.07	.88	2.95	1.96	1.47	1.18	7.76
20	2.66	.07	.97	2.66	1.77	1.33	1.06	7.00
21	2.54	.07	1.07	2.42	1.61	1.21	0.97	6.35
22	2.42	.06	1.18	2.20	1.47	1.10	0.88	5.79
23	2.32	.06	1.29	2.02	1.34	1.01	0.81	5.29
24	2.22	.06	1.40	1.85	1.23	0.93	0.74	4.86
25	2.13	.06	1.52	1.70	1.14	0.85	0.68	4.48
26	2.05	.05	1.65	1.58	1.05	0.79	0.63	4.14
27	1.97	.05	1.78	1.46	0.97	0.73	0.58	3.84
28	1.90	.05	1.91	1.36	0.90	0.68	0.54	3.57
29	1.84	.05	2.06	1.27	0.85	0.63	0.51	3.33

6″ IRON I BEAMS.—No. 16.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.47	Flange width,	3.69
Web thickness,	.22	Web thickness,	.44
Area in square inches,	4.10	Area in square inches,	5.42
Resistance,	8.47	Resistance,	9.79
Pounds per foot,	13.66	Pounds per foot,	18.06

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	6.18	.23	.09	20.60	13.73	10.30	8.24	77.78
7	5.65	.20	.12	16.14	10.76	8.07	6.46	57.14
8	4.94	.18	.16	12.35	8.23	6.18	4.94	43.75
9	4.39	.16	.20	9.76	6.50	4.88	3.90	34.57
10	3.95	.14	.24	7.90	5.27	3.95	3.16	28.00
11	3.59	.13	.29	6.53	4.35	3.26	2.61	23.14
12	3.29	.12	.35	5.48	3.66	2.74	2.19	19.44
13	3.04	.11	.41	4.68	3.12	2.34	1.87	16.57
14	2.82	.10	.48	4.03	2.69	2.01	1.61	14.29
15	2.64	.09	.55	3.52	2.35	1.76	1.41	12.44
16	2.47	.09	.63	3.09	2.06	1.54	1.24	10.94
17	2.33	.08	.71	2.74	1.83	1.37	1.10	9.69
18	2.20	.08	.79	2.44	1.63	1.22	0.98	8.64
19	2.08	.07	.88	2.19	1.46	1.09	0.88	7.76
20	1.98	.07	.97	1.98	1.32	0.99	0.79	7.00
21	1.88	.07	1.07	1.79	1.19	0.90	0.72	6.35
22	1.80	.06	1.18	1.64	1.09	0.82	0.65	5.79
23	1.72	.06	1.29	1.50	1.00	0.75	0.60	5.29
24	1.65	.06	1.40	1.38	0.92	0.69	0.55	4.86
25	1.58	.06	1.52	1.26	0.84	0.63	0.51	4.48
26	1.52	.05	1.65	1.17	0.78	0.58	0.47	4.14
27	1.46	.05	1.78	1.08	0.72	0.54	0.43	3.84
28	1.41	.05	1.91	1.01	0.67	0.50	0.40	3.57
29	1.36	.05	2.06	0.94	0.63	0.47	0.38	3.33

5″ IRON I BEAMS.—No. 17.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.06	Flange width,	3.17
Web thickness,	.26	Web thickness,	.37
Area in square inches,	3.03	Area in square inches,	3.58
Resistance,	4.88	Resistance,	5.34
Pounds per foot,	10.10	Pounds per foot,	11.93

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
4	5.69	.29	.05	28.45	18.97	14.23	11.38	145.81
5	4.55	.23	.07	18.20	12.13	9.10	7.28	93.32
6	3.80	.19	.10	12.67	8.44	6.33	5.07	64.81
7	3.25	.17	.14	9.29	6.19	4.64	3.71	47.61
8	2.85	.15	.19	7.13	4.75	3.56	2.85	36.45
9	2.53	.13	.24	5.62	3.75	2.81	2.25	28.80
10	2.28	.12	.29	4.56	3.04	2.28	1.82	23.33
11	2.07	.11	.35	3.76	2.51	1.88	1.51	19.28
12	1.90	.10	.42	3.17	2.11	1.58	1.27	16.20
13	1.75	.09	.49	2.69	1.79	1.35	1.08	13.80
14	1.63	.08	.57	2.33	1.55	1.16	0.93	11.90
15	1.52	.08	.66	2.03	1.35	1.01	0.81	10.37
16	1.42	.07	.75	1.78	1.18	0.89	0.71	9.11
17	1.34	.07	.85	1.58	1.05	0.79	0.63	8.07
18	1.27	.06	.95	1.41	0.94	0.71	0.56	7.20
19	1.20	.06	1.06	1.26	0.84	0.63	0.51	6.46
20	1.14	.06	1.17	1.14	0.76	0.57	0.46	5.83
21	1.08	.06	1.29	1.03	0.69	0.51	0.41	5.29
22	1.03	.05	1.41	0.94	0.62	0.47	0.37	4.82
23	0.99	.05	1.55	0.86	0.57	0.43	0.34	4.41
24	0.95	.05	1.69	0.79	0.53	0.39	0.31	4.05
25	0.91	.05	1.83	0.73	0.49	0.36	0.29	3.73
26	0.87	.04	1.97	0.67	0.45	0.33	0.27	3.45
27	0.84	.04	2.12	0.62	0.41	0.31	0.25	3.20

4″ IRON I BEAMS.—No. 19.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	2.60	Flange width,	2.82
Web thickness,	.22	Web thickness,	.44
Area in square inches,	2.50	Area in square inches,	3.38
Resistance,	3.30	Resistance,	3.89
Pounds per foot,	8.33	Pounds per foot,	11.26

Greatest safe load in net tons evenly distributed, including beam itself.

For a load in middle of beam, allow one-half of the tabular load.

Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
4	3.85	.23	.06	19.25	12.83	9.63	7.70	116.69
5	3.08	.19	.09	12.32	8.21	6.16	4.93	74.68
6	2.57	.16	.13	8.57	5.71	4.28	3.43	51.86
7	2.20	.13	.18	6.29	4.19	3.14	2.51	38.10
8	1.93	.12	.23	4.83	3.22	2.41	1.93	29.17
9	1.71	.10	.30	3.80	2.53	1.90	1.52	23.05
10	1.54	.09	.37	3.08	2.05	1.54	1.23	18.67
11	1.40	.08	.44	2.55	1.70	1.27	1.02	15.43
12	1.28	.08	.53	2.13	1.42	1.07	0.85	12.97
13	1.18	.07	.62	1.82	1.21	0.91	0.73	11.05
14	1.10	.07	.72	1.57	1.05	0.79	0.63	9.53
15	1.03	.06	.82	1.37	0.92	0.69	0.55	8.30

4″ IRON I BEAMS.—No. 20.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	2.30	Flange width,	2.45
Web thickness,	.16	Web thickness,	.31
Area in square inches,	1.84	Area in square inches,	2.44
Resistance,	2.51	Resistance,	2.91
Pounds per foot,	6.13	Pounds per foot,	8.13

4	2.93	.23	.06	14.65	9.77	7.33	5.86	116.69
5	2.34	.19	.09	9.36	6.24	4.68	3.74	74.68
6	1.95	.16	.13	6.50	4.33	3.25	2.60	51.86
7	1.67	.13	.18	4.77	3.18	2.39	1.91	38.10
8	1.46	.12	.23	3.65	2.43	1.83	1.46	29.17
9	1.30	.10	.30	2.89	1.93	1.44	1.16	23.05
10	1.17	.09	.37	2.34	1.56	1.17	0.94	18.67
11	1.06	.08	.44	1.93	1.28	0.96	0.77	15.43
12	0.98	.08	.53	1.63	1.09	0.82	0.65	12.97
13	0.90	.07	.62	1.38	0.92	0.69	0.55	11.05
14	0.84	.07	.72	1.20	0.80	0.60	0.48	9.53
15	0.78	.06	.82	1.04	0.69	0.52	0.42	8.30

3″ IRON I BEAMS.—No. 21.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	2.40	Flange width,	2.62
Web thickness,	.22	Web thickness,	.44
Area in square inches,	2.06	Area in square inches,	2.72
Resistance,	1.99	Resistance,	2.32
Pounds per foot,	6.86	Pounds per foot,	9.06

Greatest safe load in net tons evenly distributed, including beam itself.

For a load in middle of beam, allow one-half of the tabular load.

Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
4	2.32	.18	.08	11.60	7.73	5.80	4.64	87.50
5	1.86	.14	.12	7.44	4.96	3.72	2.98	56.00
6	1.55	.12	.18	5.17	3.44	2.58	2.07	38.89
7	1.33	.10	.24	3.80	2.53	1.90	1.52	28.57
8	1.16	.09	.31	2.90	1.93	1.45	1.16	21.88
9	1.03	.08	.39	2.29	1.53	1.14	0.92	17.28
10	0.93	.07	.49	1.86	1.24	0.93	0.74	14.00
11	0.84	.06	.59	1.53	1.02	0.76	0.61	11.57
12	0.77	.06	.71	1.28	0.86	0.64	0.51	9.72
13	0.71	.05	.83	1.09	0.73	0.55	0.44	8.28
14	0.66	.05	.96	0.94	0.63	0.47	9.38	7.14
15	0.62	.05	1.10	0.83	0.55	0.41	0.33	6.22

3″ IRON I BEAMS.—No. 22.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	2.20	Flange width,	2.35
Web thickness,	.16	Web thickness,	.31
Area in square inches,	1.58	Area in square inches,	2.03
Resistance,	1.61	Resistance,	1.83
Pounds per foot,	5.26	Pounds per foot,	6.76

4	1.88	.18	.08	9.40	6.27	4.70	3.76	87.50
5	1.50	.14	.12	6.00	4.00	3.00	2.40	56.00
6	1.25	.12	.18	4.17	2.78	2.08	1.67	38.89
7	1.07	.10	.24	3.06	2.04	1.53	1.22	28.57
8	0.94	.09	.31	2.35	1.57	1.18	0.94	21.88
9	0.83	.08	.39	1.84	1.23	0.92	0.74	17.28
10	0.75	.07	.49	1.50	1.00	0.75	0.60	14.00
11	0.68	.06	.59	1.24	0.82	0.62	0.49	11.57
12	0.63	.06	.71	1.05	0.70	0.53	0.42	9.72
13	0.58	.05	.83	0.89	0.59	0.45	0.36	8.28
14	0.54	.05	.96	0.77	0.51	0.39	0.31	7.14
15	0.50	.05	1.10	0.67	0.44	0.33	0.27	6.22

15″ STEEL I BEAMS.—No. 521.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.61	Flange width,	5.80
Web thickness,	.41	Web thickness,	.60
Area in square inches,	12.47	Area in square inches,	15.32
Resistance,	59.13	Resistance,	66.25
Pounds per foot,	42.39	Pounds per foot,	52.08

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	26.84	.42	.10	54.65	36.43	27.32	21.86	81.00
11	26.84	.38	.13	49.68	33.12	24.84	19.87	66.94
12	26.84	.35	.16	45.54	30.36	22.78	18.22	56.25
13	25.48	.32	.19	39.19	26.12	19.60	15.67	47.92
14	23.65	.30	.23	33.79	22.52	16.90	13.51	41.33
15	22.08	.28	.26	29.44	19.63	14.72	11.77	36.00
16	20.70	.25	.30	25.87	17.26	12.94	10.36	31.64
17	19.48	.24	.34	22.91	15.28	11.46	9.17	28.03
18	18.40	.23	.38	20.44	13.63	10.22	8.17	25.00
19	17.42	.22	.42	18.34	12.23	9.17	7.33	22.44
20	16.56	.22	.47	16.56	11.04	8.28	6.62	20.25
21	15.77	.20	.51	15.01	10.01	7.51	6.01	18.37
22	15.05	.19	.56	13.68	9.12	6.84	5.47	16.74
23	14.40	.18	.61	12.52	8.35	6.26	5.00	15.31
24	13.80	.18	.67	11.50	7.67	5.75	4.60	14.06
25	13.25	.16	.72	10.20	7.07	5.30	4.24	12.96
26	12.73	.16	.78	9.79	6.53	4.90	3.91	11.98
27	12.26	.16	.84	9.08	6.06	4.55	3.64	11.11
28	11.83	.16	.90	8.45	5.64	4.22	3.38	10.33
29	11.42	.14	.97	7.88	5.26	3.94	3.16	9.63
30	11.04	.14	1.04	7.36	4.91	3.68	2.94	9.00
31	10.68	.13	1.11	6.89	4.60	3.44	2.76	8.43
32	10.34	.13	1.18	6.47	4.31	3.23	2.59	7.91
33	10.03	.13	1.26	6.08	4.06	3.04	2.44	7.44

15″ STEEL I BEAMS.—No. 522.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.8	Flange width,	5.95
Web thickness,	.45	Web thickness,	.60
Area in square inches,	14.51	Area in square inches,	16.76
Resistance,	66.28	Resistance,	71.91
Pounds per foot,	49.32	Pounds per foot,	56.98

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{5}{16}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
10	31.98	.42	.10	63.96	41.60	31.98	25.58	81.00
11	31.98	.38	.13	58.14	38.76	29.07	23.26	66.94
12	30.37	.35	.16	50.61	33.74	25.30	20.24	56.25
13	28.04	.32	.19	43.13	28.75	21.67	17.25	47.92
14	26.03	.30	.23	37.18	24.78	18.59	14.87	41.33
15	24.30	.28	.26	32.40	21.60	16.20	12.96	36.00
16	22.78	.25	.30	28.47	18.98	14.23	11.39	31.64
17	21.44	.24	.34	25.22	16.81	12.61	10.09	28.03
18	20.25	.23	.38	22.50	15.00	11.25	9.00	25.00
19	19.18	.22	.42	20.18	13.45	10.09	8.07	22.24
20	18.22	.22	.47	18.22	12.14	9.11	7.29	20.25
21	17.36	.20	.51	16.53	11.02	8.26	6.61	18.37
22	16.56	.19	.56	15.05	10.03	7.52	6.02	16.74
23	15.85	.18	.61	13.78	9.18	6.89	5.51	15.31
24	15.18	.18	.67	12.65	8.43	6.32	5.06	14.06
25	14.58	.16	.72	11.64	7.76	5.82	4.65	12.96
26	14.02	.16	.78	10.78	7.18	5.39	4.31	11.98
27	13.50	.16	.84	10.00	6.66	5.00	4.00	11.11
28	13.01	.16	.90	9.25	6.16	4.63	3.80	10.33
29	12.57	.14	.97	8.66	5.77	4.33	3.46	9.63
30	12.15	.14	1.04	8.10	5.40	4.05	3.24	9.00
31	11.75	.13	1.11	7.58	5.05	3.79	3.03	8.43
32	11.39	.13	1.18	7.12	4.74	3.56	2.84	7.91
33	11.04	.13	1.26	6.60	4.45	3.34	2.67	7.44

15″ STEEL I BEAMS.—No. 523.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	6.10	Flange width,	6.85
Web thickness,	.50	Web thickness,	.75
Area in square inches,	16.95	Area in square inches,	20.70
Resistance,	77.83	Resistance,	87.21
Pounds per foot,	57.63	Pounds per foot,	70.38

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
10	38.67	.42	.10	77.34	51.56	38.67	30.94	81.00
11	38.67	.38	.13	70.30	46.86	35.15	28.12	66.94
12	35.67	.35	.16	59.45	39.63	29.73	23.78	56.25
13	32.15	.32	.19	49.46	32.97	24.73	19.78	47.92
14	30.57	.30	.23	43.67	29.11	21.84	17.47	41.33
15	28.53	.28	.26	38.04	25.36	19.02	15.22	36.00
16	26.75	.25	.30	33.43	22.28	16.72	13.37	31.64
17	25.18	.24	.34	29.62	19.74	14.81	11.85	28.03
18	23.78	.23	.38	26.42	17.61	13.21	10.57	25.00
19	22.53	.22	.42	23.87	15.91	11.92	9.55	22.24
20	21.40	.22	.47	21.40	14.26	10.70	8.56	20.25
21	20.38	.20	.51	19.45	12.96	9.72	7.78	18.37
22	19.45	.19	.56	17.68	11.78	8.84	7.07	16.74
23	18.61	.18	.61	16.18	10.78	8.09	6.47	15.31
24	17.83	.18	.67	14.85	9.90	7.42	5.94	14.06
25	17.12	.16	.72	13.69	9.12	6.84	5.48	12.96
26	16.46	.16	.78	12.66	8.44	6.33	5.06	11.98
27	15.85	.16	.84	11.74	7.82	5.82	4.70	11.11
28	15.28	.16	.90	10.91	7.27	5.43	4.36	10.33
29	14.76	.14	.97	10.17	6.78	5.08	4.07	9.63
30	14.26	.14	1.04	9.51	6.34	4.75	3.80	9.00
31	13.80	.13	1.11	8.90	5.93	4.45	3.56	8.43
32	13.37	.13	1.18	8.65	5.76	4.32	3.46	7.91
33	12.97	.13	1.26	7.86	5.24	3.93	3.14	7.44

15″ STEEL I BEAMS.—No. 524.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	6.4	Flange width,	6.71
Web thickness,	.59	Web thickness,	.90
Area in square inches,	20.54	Area in square inches,	25.19
Resistance,	93.93	Resistance,	105.56
Pounds per foot,	69.80	Pounds per foot,	85.64

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	51.02	.42	.10	102.04	68.02	51.08	40.82	81.00
11	46.96	.38	.13	85.38	56.92	42.69	34.15	66.94
12	43.05	.35	.16	71.75	47.83	35.87	28.7	56.25
13	39.74	.32	.19	61.13	40.75	30.56	24.45	47.92
14	36.90	.30	.23	52.71	35.14	26.35	21.08	41.33
15	34.44	.28	.26	45.92	30.61	22.96	18.37	36.00
16	32.28	.25	.30	43.50	29.00	21.75	17.40	31.64
17	30.38	.24	.34	35.74	23.82	17.87	14.30	28.03
18	28.70	.23	.38	31.98	21.32	15.99	12.79	25.00
19	26.61	.22	.42	28.01	15.34	14.00	11.20	22.24
20	25.83	.22	.47	25.83	17.22	12.91	10.33	20.25
21	24.60	.20	.51	22.31	14.87	11.15	8.92	18.37
22	23.48	.19	.56	21.34	14.22	10.67	8.54	16.74
23	22.46	.18	.61	19.53	13.02	9.76	7.81	15.31
24	21.52	.18	.67	17.92	11.74	8.96	7.17	14.06
25	20.66	.16	.72	16.52	11.01	8.26	6.60	12.96
26	19.87	.16	.78	15.28	10.18	7.64	6.11	11.98
27	19.13	.16	.84	14.17	9.44	7.08	5.67	11.11
28	18.45	.16	.90	13.17	8.78	6.58	5.27	10.33
29	17.81	.14	.97	12.28	8.18	6.14	4.91	9.63
30	17.22	.14	1.04	11.48	7.65	5.74	4.59	9.00
31	16.66	.13	1.11	10.74	7.16	5.38	4.30	8.43
32	16.14	.13	1.18	10.08	6.72	5.04	4.03	7.91
33	15.65	.13	1.26	9.48	6.32	4.74	3.79	7.44

12″ STEEL I BEAMS.—No. 3.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.50	Flange width,	5.65
Web thickness,	.65	Web thickness,	.80
Area in square inches,	17.12	Area in square inches,	18.92
Resistance,	62.55	Resistance,	66.15
Pounds per foot,	58.20	Pounds per foot,	64.32

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
10	35.03	.34	.14	70.06	46.70	35.03	28.02	64.80
11	31.85	.30	.17	57.90	38.60	28.96	23.16	53.55
12	29.20	.27	.20	48.66	32.44	24.34	19.46	45.00
13	26.94	.25	.24	41.45	27.64	20.72	16.58	38.34
14	25.02	.24	.28	35.75	23.83	17.87	14.49	33.06
15	23.35	.23	.32	31.14	20.76	15.56	12.46	28.80
16	21.89	.22	.37	27.36	18.24	13.68	10.94	25.31
17	20.60	.21	.42	24.24	16.16	12.12	10.68	22.42
18	19.46	.19	.47	21.62	14.40	10.81	8.65	20.00
19	18.43	.18	.53	19.40	12.94	9.70	7.76	17.89
20	17.52	.17	.59	17.52	11.68	8.76	7.01	16.20
21	16.68	.16	.65	15.89	10.60	7.94	6.36	14.68
22	15.92	.15	.71	14.47	9.65	7.24	5.80	13.39
23	15.23	.14	.77	13.24	8.83	6.62	5.29	12.25
24	14.59	.14	.84	12.16	8.11	6.08	4.86	11.25
25	14.02	.13	.91	11.21	7.48	5.60	4.49	10.37
26	13.48	.13	.98	10.37	6.91	5.18	4.15	9.59
27	12.97	.12	1.06	9.61	6.41	4.81	3.84	8.88
28	12.52	.12	1.14	8.94	5.96	4.48	3.58	8.27
29	12.08	.12	1.22	8.33	5.56	4.16	3.34	7.71
30	11.68	.11	1.30	7.81	5.18	3.89	3.11	7.20
31	11.30	.11	1.39	7.30	4.86	3.65	2.92	6.74
32	10.94	.11	1.50	6.84	4.56	3.42	2.74	6.33
33	10.62	.10	1.61	6.43	4.30	3.22	2.58	5.95

12″ STEEL I BEAMS.—No. 4.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.79	Flange width,	5.02
Web thickness,	.45	Web thickness,	.68
Area in square inches,	12.03	Area in square inches,	14.76
Resistance,	45.60	Resistance,	51.12
Pounds per foot,	40.90	Pounds per foot,	50.18

Greatest safe load in net tons evenly distributed, including beam itself.

For a load in middle of beam, allow one-half of the tabular load.

Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	25.54	.34	.14	51.07	34.04	25.54	20.42	64.80
11	23.22	.30	.17	42.22	28.14	21.11	16.88	53.55
12	21.28	.27	.20	35.46	23.64	17.74	14.18	45.00
13	19.64	.25	.24	30.22	20.15	15.11	12.08	38.34
14	18.24	.24	.28	26.05	17.38	13.03	10.42	33.06
15	17.03	.23	.32	22.70	15.13	11.35	9.09	28.80
16	15.96	.22	.37	19.94	13.30	9.97	7.98	25.31
17	15.02	.21	.42	17.68	11.78	8.83	7.07	22.42
18	14.18	.19	.47	15.76	10.51	7.88	6.30	20.00
19	13.44	.18	.53	14.15	9.43	7.07	5.66	17.89
20	12.77	.17	.59	12.77	8.51	6.38	5.11	16.20
21	12.16	.16	.65	11.58	7.72	5.78	4.63	14.68
22	11.60	.15	.71	10.55	7.03	5.28	4.22	13.39
23	11.10	.14	.77	9.65	6.43	4.82	3.86	12.25
24	10.64	.14	.84	8.87	5.92	4.44	3.55	11.25
25	10.21	.13	.91	8.17	5.45	4.08	3.26	10.37
26	9.82	.13	.98	7.55	5.03	3.78	3.02	9.59
27	9.46	.12	1.06	7.01	4.67	3.50	2.80	8.88
28	9.12	.12	1.14	6.52	4.34	3.25	2.60	8.27
29	8.81	.12	1.22	6.07	4.04	3.04	2.42	7.71
30	8.51	.11	1.30	5.68	3.78	2.83	2.27	7.20
31	8.23	.11	1.39	5.32	3.54	2.65	2.12	6.74
32	7.98	.11	1.50	4.99	3.32	2.50	1.99	6.33
33	7.74	.10	1.61	4.69	3.13	2.34	1.87	5.95

12″ STEEL I BEAMS.—No. 515.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.00	Flange width,	5.18
Web thickness,	.35	Web thickness,	.53
Area in square inches,	9.01	Area in square inches,	11.24
Resistance,	34.65	Resistance,	38.96
Pounds per foot,	30.63	Pounds per foot,	38.21

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Load as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	19.40	.34	.14	38.81	25.87	19.40	15.53	64.80
11	17.64	.30	.17	32.08	21.38	16.03	12.83	53.55
12	16.18	.27	.20	26.96	17.97	13.48	10.79	45.00
13	14.93	.25	.24	22.97	15.31	11.48	9.19	38.34
14	13.86	.24	.28	19.80	13.20	9.90	7.90	33.06
15	12.94	.23	.32	17.24	11.50	8.63	6.90	28.80
16	12.13	.22	.37	15.17	10.12	7.58	6.07	25.31
17	11.41	.21	.42	13.43	8.95	6.71	5.38	22.42
18	10.78	.19	.47	11.98	7.98	5.99	4.79	20.00
19	10.21	.18	.53	10.75	7.16	5.38	4.30	17.89
20	9.71	.17	.59	9.71	6.47	4.86	3.89	16.20
21	9.24	.16	.65	8.80	5.87	4.40	3.62	14.68
22	8.82	.15	.71	8.02	5.34	4.01	3.20	13.39
23	8.44	.14	.77	7.33	4.90	3.67	2.94	12.25
24	8.09	.14	.84	6.74	4.49	3.37	2.70	11.25
25	7.76	.13	.91	6.22	4.14	3.11	2.48	10.37
26	7.46	.13	.98	5.74	3.83	2.87	2.29	9.59
27	7.19	.12	1.06	5.33	3.55	2.66	2.12	8.88
28	6.94	.12	1.14	4.96	3.30	2.47	1.98	8.27
29	6.70	.12	1.22	4.62	3.08	2.30	1.85	7.71
30	6.47	.11	1.30	4.31	2.88	2.16	1.73	7.20
31	6.26	.11	1.39	4.04	2.69	2.02	1.62	6.74
32	6.06	.11	1.50	3.79	2.52	1.90	1.51	6.33
33	5.88	.10	1.61	3.56	2.38	1.78	1.43	5.95

12″ STEEL I BEAMS.—No. 516.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.5	Flange width,	5.7
Web thickness,	.40	Web thickness,	.60
Area in square inches,	11.95	Area in square inches,	14.35
Resistance,	45.31	Resistance,	50.61
Pounds per foot,	40.63	Pounds per foot,	29.32

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
10	24.75	.34	.14	49.50	33.00	24.75	19.80	64.80
11	22.90	.30	.17	41.63	27.75	20.82	16.55	53.55
12	20.99	.27	.20	34.98	23.32	17.49	13.99	45.00
13	19.38	.25	.24	29.81	19.87	14.92	11.92	38.34
14	17.99	.24	.28	25.70	17.13	12.85	10.28	33.06
15	16.79	.23	.32	22.38	14.92	11.19	8.95	28.80
16	15.74	.22	.37	19.05	12.70	9.53	7.62	25.31
17	14.82	.21	.42	17.43	11.62	8.72	6.97	22.42
18	13.99	.19	.47	15.54	10.36	7.77	6.21	20.00
19	13.26	.18	.53	13.95	9.30	6.98	5.58	17.89
20	12.59	.17	.59	12.59	8.39	6.29	5.13	16.20
21	11.99	.16	.65	11.41	7.60	5.71	4.56	14.68
22	11.45	.15	.71	10.40	6.93	5.20	4.16	13.39
23	11.38	.14	.77	9.90	6.60	4.95	3.96	12.25
24	10.49	.14	.84	8.74	5.82	4.37	3.49	11.25
25	10.07	.13	.91	8.05	5.36	4.02	3.22	10.37
26	9.69	.13	.98	7.46	4.97	3.73	2.98	9.59
27	9.33	.12	1.06	6.91	4.60	3.45	2.76	8.88
28	8.99	.12	1.14	6.42	4.28	3.21	2.56	8.27
29	8.69	.12	1.22	5.99	4.00	2.99	2.39	7.71
30	8.40	.11	1.30	5.60	3.73	2.80	2.24	7.20
31	8.12	.11	1.39	5.24	3.49	2.62	2.09	6.74
32	7.87	.11	1.50	4.91	3.27	2.45	1.96	6.33
33	7.63	.10	1.61	4.62	3.08	2.31	1.84	5.95

10½″ STEEL I BEAMS.—No. 5.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.25	Flange width,	5.50
Web thickness,	.47	Web thickness,	.72
Area in square inches,	13.53	Area in square inches,	16.16
Resistance,	46.21	Resistance,	50.80
Pounds per foot,	46.00	Pounds per foot,	54.94

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Load as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	25.88	.29	.17	51.77	34.51	25.88	20.71	56.70
11	23.52	.26	.20	42.77	28.51	21.38	17.10	46.86
12	21.56	.24	.24	35.94	23.96	17.98	14.38	39.38
13	19.91	.22	.28	30.62	20.42	15.31	12.25	33.55
14	18.48	.20	.32	26.40	17.60	13.20	10.56	28.93
15	17.26	.19	.37	23.00	15.34	11.51	9.20	25.20
16	16.18	.18	.42	20.22	13.48	10.12	8.09	22.15
17	15.23	.17	.48	17.92	11.94	8.95	7.16	19.62
18	14.38	.16	.54	15.97	10.64	7.99	6.38	17.50
19	13.62	.15	60	14.34	9.55	7.16	5.74	15.71
20	12.94	.14	.67	12.94	8.63	6.47	5.17	14.18
21	12.32	.14	.74	11.74	7.82	5.87	4.69	12.86
22	11.76	.13	.81	10.69	7.13	5.34	4.27	11.72
23	11.26	.13	.89	9.79	6.53	4.90	3.91	10.72
24	10.79	.12	.97	8.99	5.99	4.50	3.60	9.84
25	10.36	.12	1.05	8.28	5.52	4.14	3.31	9.07
26	9.95	.11	1.14	7.66	5.10	3.83	3.06	8.39
27	9.59	.11	1.22	7.10	4.74	3.55	2.84	7.78
28	9.24	.11	1.32	6.60	4.40	3.30	2.64	7.23
29	8.93	.10	1.42	6.16	4.10	3.08	2.46	6.74
30	8.63	.10	1.52	5.75	3.84	2.88	2.30	6.30
31	8.35	.09	1.62	5.39	3.59	2.70	2.16	5.90
32	8.09	.09	1.72	5.05	3.37	2.53	2.03	5.54
33	7.85	.08	1.83	4.75	3.17	2.38	1.91	5.21

$10\frac{1}{2}''$ STEEL I BEAMS.—No. $5\frac{1}{2}$.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.87	Flange width,	5.12
Web thickness,	.41	Web thickness,	.66
Area in square inches,	10.96	Area in square inches,	13.58
Resistance,	37.52	Resistance,	42.11
Pounds per foot,	37.26	Pounds per foot,	46.16

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	21.01	.29	.17	42.02	28.02	21.01	16.81	56.70
11	19.10	.26	.20	34.74	23.16	17.36	13.90	46.86
12	17.51	.24	.24	29.18	19.45	14.59	11.68	39.38
13	16.16	.22	.28	24.81	16.58	12.43	9.95	33.55
14	15.01	.20	.32	21.44	14.29	10.73	8.58	28.93
15	14.00	.19	.37	18.67	12.44	9.34	7.46	25.20
16	13.09	.18	.42	16.42	10.94	8.21	6.56	22.15
17	12.36	.17	.48	14.54	9.70	7.27	5.82	19.62
18	11.68	.16	.54	12.97	8.65	6.49	5.18	17.50
19	11.06	.15	.60	11.65	7.76	5.82	4.66	15.71
20	10.50	.14	.67	10.50	7.00	5.26	4.20	14.18
21	10.01	.14	.74	9.53	6.36	4.76	3.82	12.86
22	9.55	.13	.81	8.69	5.78	4.34	3.47	11.72
23	9.13	.13	.89	7.94	5.29	3.97	3.18	10.72
24	8.76	.12	.97	7.30	4.87	3.65	2.92	9.84
25	8.40	.12	1.05	6.72	4.48	3.36	2.69	9.07
26	8.08	.11	1.14	6.22	4.14	3.11	2.48	8.39
27	7.78	.11	1. 22	5.76	3.84	2.88	2.30	7.78
28	7.50	.11	1.32	5.35	3.58	2.68	2.15	7.23
29	7.25	.10	1.42	5.00	3.34	2.50	2.00	6.74
30	7.01	.10	1.52	4.67	3.12	2.34	1.87	6.30
31	6.78	.09	1.62	4.38	2.92	2.18	1.75	5.90
32	6.56	.09	1.72	4.10	2.74	2.05	1.64	5.54
33	6.37	.08	1.83	3.86	2.58	1.93	1.55	5.21

10½″ STEEL I BEAMS.—No. 6.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.50	Flange width,	4.68
Web thickness,	.35	Web thickness,	.53
Area in square inches,	9.00	Area in square inches,	10.89
Resistance,	31.15	Resistance,	34.46
Pounds per foot,	30.60	Pounds per foot,	37.03

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
10	17.45	.29	.17	34.90	23.27	17.45	13.96	56.70
11	15.85	.26	.20	28.82	19.21	14.41	11.53	46.86
12	14.53	.24	.24	24.22	16.15	12.11	9.68	39.38
13	13.42	.22	.28	20.64	13.76	10.32	8.26	33.55
14	12.46	.20	.32	17.80	11.87	8.89	7.12	28.93
15	11.63	.19	.37	15.50	10.33	7.75	6.20	25.20
16	10.91	.18	.42	13.63	9.10	6.82	5.46	22.15
17	10.26	.17	.48	12.07	8.05	6.04	4.82	19.62
18	9.70	.16	.54	10.78	7.19	5.39	4.31	17.50
19	9.18	.15	.60	9.66	6.44	4.84	3.86	15.71
20	8.72	.14	.67	8.72	5.82	4.37	3.49	14.18
21	8.30	.14	.74	7.91	5.27	3.96	3.17	12.86
22	7.93	.13	.81	7.21	4.81	3.60	2.88	11.72
23	7.58	.13	.89	6.60	4.39	3.30	2.64	10.72
24	7.27	.12	.97	6.06	4.04	3.04	2.42	9.84
25	6.97	.12	1.05	5.58	3.72	2.78	2.23	9.07
26	6.71	.11	1.14	5.16	3.44	2.58	2.06	8.39
27	6.46	.11	1.22	4.79	3.19	2.39	1.91	7.78
28	6.23	.11	1.32	4.45	2.96	2.22	1.78	7.23
29	6.01	.10	1.42	4.15	2.76	2.08	1.66	6.74
30	5.82	.10	1.52	3.88	2.59	1.94	1.55	6.30
31	5.63	.09	1.62	3.64	2.42	1.81	1.45	5.90
32	5.45	.09	1.72	3.41	2.27	1.70	1.37	5.54
33	5.28	.08	1.83	3.20	2.14	1.60	1.28	5.21

10″ STEEL I BEAMS.—No. 7.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.63	Flange width,	4.88
Web thickness,	.50	Web thickness,	.75
Area in square inches,	11.25	Area in square inches,	13.75
Resistance,	34.87	Resistance,	39.04
Pounds per foot,	38.25	Pounds per foot,	46.75

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
10	19.52	.28	.18	39.05	26.03	19.52	15.62	54.00
11	17.75	.25	.21	32.27	21.52	16.14	12.89	44.64
12	16.27	.23	.25	27.12	18.08	13.56	10.85	37.50
13	15.02	.21	.30	23.11	15.41	11.56	9.24	31.95
14	13.94	.20	.35	19.92	13.28	9.96	7.97	27.55
15	13.02	.19	.40	17.36	11.57	8.68	6.95	24.00
16	12.20	.18	.45	15.25	10.18	7.63	6.11	21.09
17	11.48	.17	.51	13.51	9.01	6.76	5.40	18.69
18	10.85	.16	.57	12.05	8.04	6.02	4.82	16.67
19	10.27	.15	.64	10.81	7.21	5.41	4.32	14.96
20	9.77	.14	.71	9.77	6.52	4.88	3.91	13.50
21	9.30	.13	.78	8.86	5.90	4.43	3.54	12.25
22	8.88	.13	.85	8.08	5.38	4.03	3.23	11.16
23	8.48	.12	.93	7.38	4.92	3.68	2.95	10.21
24	8.14	.12	1.01	6.78	4.52	3.40	2.71	9.37
25	7.81	.11	1.10	6.25	4.16	3.12	2.50	8.64
26	7.51	.11	1.19	5.78	3.75	2.89	2.32	7.99
27	7.24	.11	1.28	5.46	3.58	2.68	2.15	7.41
28	6.97	.10	1.38	4.98	3.32	2.50	1.99	6.89
29	6.73	.10	1.48	4.64	3.10	2.32	1.86	6.42
30	6.50	.09	1.58	4.33	2.89	2.17	1.74	6.00
31	6.30	.09	1.69	4.07	2.71	2.03	1.62	5.62
32	6.11	.08	1.80	3.82	2.54	1.91	1.52	5.27
33	5.92	.08	1.92	3.59	2.39	1.79	1.43	4.96

10″ STEEL I BEAMS.—No. 8.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.38	Flange width,	4.53
Web thickness,	.35	Web thickness,	.50
Area in square inches,	9.14	Area in square inches,	10.64
Resistance,	30.23	Resistance,	32.72
Pounds per foot,	31.07	Pounds per foot,	36.17

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
10	16.93	.28	.18	33.86	22.57	16.93	13.55	54.00
11	15.38	.25	.21	27.97	18.65	13.98	11.18	44.64
12	14.11	.23	.25	23.52	15.68	11.76	9.41	37.50
13	13.02	.21	.30	20.03	13.36	10.02	8.02	31.95
14	12.10	.20	.35	17.28	11.52	8.64	6.91	27.55
15	11.28	.19	.40	15.04	10.03	7.52	6.01	24.00
16	10.58	.18	.45	13.24	8.82	6.61	5.29	21.09
17	9.96	.17	.51	11.71	7.81	5.86	4.69	18.69
18	9.41	.16	.57	10.45	6.97	5.23	4.18	16.67
19	8.90	.15	.64	9.37	6.25	4.69	3.74	14.96
20	8.46	.14	.71	8.46	5.64	4.24	3.38	13.50
21	8.06	.13	.78	7.68	5.12	3.84	3.07	12.25
22	7.69	.13	.85	7.00	4.66	3.49	2.80	11.16
23	7.36	.12	.93	6.40	4.26	3.20	2.56	10.21
24	7.04	.12	1.01	5.87	3.91	2.94	2.35	9.37
25	6.77	.11	1.10	5.41	3.61	2.71	2.16	8.64
26	6.52	.11	1.19	5.02	3.34	2.51	2.00	7.99
27	6.26	.11	1.28	4.64	3.10	2.32	1.86	7.41
28	6.05	.10	1.38	4.32	2.88	2.16	1.73	6.89
29	5.83	.10	1.48	4.02	2.68	2.02	1.61	6.42
30	5.64	.09	1.58	3.76	2.51	1.88	1.50	6.00
31	5.46	.09	1.69	3.53	2.35	1.76	1.40	5.62
32	5.29	.08	1.80	3.31	2.21	1.66	1.32	5.27
33	5.12	.08	1.92	3.11	2.08	1.55	1.25	4.96

10″ STEEL I BEAMS.—No. 511.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.50	Flange width,	4.70
Web thickness,	.30	Web thickness,	.50
Area in square inches,	6.83	Area in square inches,	8.83
Resistance,	22.48	Resistance,	25.81
Pounds per foot,	23.21	Pounds per foot,	30.02

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
10	12.59	.28	.18	25.18	16.79	12.59	10.07	54.00
11	11.44	.25	.21	20.80	15.26	10.40	8.32	44.64
12	10.49	.23	.25	17.48	11.66	8.74	6.99	37.50
13	9.68	.21	.30	14.89	9.93	7.45	5.96	31.95
14	8.99	.20	.35	12.84	8.56	6.42	5.14	27.55
15	8.39	.19	.40	11.19	7.46	5.60	4.47	24.00
16	7.87	.18	.45	9.84	6.56	4.92	3.94	21.09
17	7.41	.17	.51	8.72	5.81	4.36	3.49	18.69
18	6.99	.16	.57	7.77	5.18	3.88	3.11	16.67
19	6.63	.15	.64	6.98	4.65	3.49	2.79	14.96
20	6.29	.14	.71	6.29	4.19	3.15	2.52	13.50
21	5.99	.13	.78	5.70	3.80	2.85	2.28	12.25
22	5.72	.13	.85	5.20	3.47	2.60	2.08	11.16
23	5.47	.12	.93	4.76	3.17	2.38	1.90	10.21
24	5.25	.12	1.01	4.38	2.92	2.19	1.75	9.37
25	5.04	.11	1.10	4.00	2.69	2.00	1.61	8.64
26	4.84	.11	1.19	3.73	2.48	1.87	1.49	7.99
27	4.66	.11	1.28	3.45	2.30	1.73	1.38	7.41
28	4.49	.10	1.38	3.21	2.14	1.61	1.28	6.89
29	4.34	.10	1.48	2.99	2.00	1.50	1.20	6.42
30	4.20	.09	1.58	2.80	1.87	1.40	1.12	6.00
31	4.06	.09	1.69	2.62	1.75	1.31	1.05	5.62
32	3.93	.08	1.80	2.46	1.64	1.23	.98	5.27
33	3.81	.08	1.92	2.31	1.54	1.16	.92	4.96

9″ STEEL I BEAMS.—No. 9.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.75	Flange width,	4.94
Web thickness,	.41	Web thickness,	.6
Area in square inches,	9.28	Area in square inches,	10.99
Resistance,	27.10	Resistance,	29.66
Pounds per foot,	31.55	Pounds per foot,	37.36

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
8	18.97	.31	.12	47.44	31.62	23.71	18.97	75.94
9	16.86	.28	.15	37.46	24.97	18.73	14.99	60.00
10	15.18	.25	.19	30.36	20.24	15.18	12.14	48.60
11	13.80	.23	.23	25.09	16.73	12.54	10.03	40.17
12	12.65	.20	.28	21.08	14.05	10.54	8.44	33.75
13	11.68	.19	.33	17.96	11.98	8.98	7.19	28.76
14	10.84	.18	.38	15.48	10.32	7.74	6.19	24.80
15	10.12	.17	.44	13.49	8.99	6.74	5.40	21.67
16	9.48	.16	.50	11.86	7.90	5.93	4.74	18.98
17	8.93	.15	.56	10.50	7.01	5.26	4.20	16.82
18	8.44	.14	.63	9.3	6.25	4.69	3.74	15.00
19	7.99	.13	.70	8.41	5.60	4.21	3.36	13.46
20	7.58	.12	.78	7.58	5.05	3.79	3.04	12.15
21	7.22	.12	.86	6.88	4.58	3.44	2.75	11.02
22	6.90	.11	.94	6.28	4.18	3.13	2.51	10.04
23	6.60	.11	1.03	5.74	3.83	2.87	2.29	9.19
24	6.32	.11	1.12	5.27	3.52	2.64	2.11	8.44
25	6.07	.10	1.22	4.86	3.24	2.42	1.94	7.76
26	5.83	.10	1.32	4.49	2.99	2.25	1.80	7.19
27	5.62	.09	1.42	4.16	2.77	2.08	1.67	6.67
28	5.42	.09	1.53	3.88	2.58	1.93	1.55	6.19
29	5.23	.08	1.64	3.61	2.40	1.80	1.44	5.78
30	5.06	.08	1.76	3.37	2.24	1.69	1.34	5.40
31	4.90	.07	1.88	3.16	2.10	1.58	1.26	5.06

9″ STEEL I BEAMS.—No. 10.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.25	Flange width,	4.44
Web thickness,	.31	Web thickness,	.50
Area in square inches,	7.18	Area in square inches,	8.89
Resistance,	21.48	Resistance,	24.05
Pounds per foot,	24.41	Pounds per foot,	30.22

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
8	14.73	.31	.12	37.50	25.00	18.76	15.00	75.94
9	13.37	.28	.15	29.71	19.80	14.86	11.88	60.00
10	12.02	.25	.19	24.05	16.03	12.02	9.62	48.60
11	10.93	.23	.23	19.87	13.25	9.94	7.96	40.17
12	10.02	.20	.28	16.70	11.14	8.35	6.68	33.75
13	9.25	.19	.33	14.23	9.49	7.12	5.69	28.76
14	8.59	.18	.38	12.28	8.18	6.13	4.91	24.80
15	8.02	.17	.44	10.69	7.13	5.34	4.27	21.67
16	7.52	.16	.50	9.41	6.28	4.70	3.77	18.98
17	7.08	.15	.56	8.33	5.56	4.16	3.34	16.82
18	6.68	.14	.63	7.43	4.96	3.71	2.98	15.00
19	6.34	.13	.70	6.67	4.45	3.34	2.66	13.46
20	6.01	.12	.78	6.01	4.01	3.01	2.40	12.15
21	5.72	.12	.86	5.45	3.64	2.72	2.18	11.02
22	5.47	.11	.94	4.98	3.31	2.48	1.99	10.04
23	5.23	.11	1.03	4.55	3.04	2.27	1.82	9.19
24	5.02	.11	1.12	4.18	2.78	2.09	1.67	8.44
25	4.81	.10	1.22	3.85	2.57	1.92	1.54	7.76
26	4.63	.10	1.32	3.56	2.38	1.78	1.43	7.19
27	4.45	.09	1.42	3.30	2.20	1.64	1.32	6.67
28	4.30	.09	1.53	3.07	2.04	1.54	1.22	6.19
29	4.15	.08	1.64	2.87	1.91	1.43	1.14	5.78
30	4.01	.08	1.76	2.68	1.78	1.33	1.07	5.40
31	3.88	.07	1.88	2.50	1.67	1.25	1.00	5.06

9″ STEEL I BEAMS.—No. 509.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.30	Flange width,	4.46
Web thickness,	.28	Web thickness,	.44
Area in square inches,	5.97	Area in square inches,	7.41
Resistance,	17.95	Resistance,	20.11
Pounds per foot,	20.30	Pounds per foot,	25.19

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
8	12.30	.31	.12	30.75	20.50	15.38	12.30	75.94
9	11.17	.28	.15	24.82	16.55	12.41	9.90	60.00
10	10.05	.25	.19	20.10	13.40	10.05	8.04	48.60
11	9.14	.23	.23	16.62	11.08	8.31	6.65	40.17
12	8.38	.20	.28	13.97	9.31	6.98	5.59	33.75
13	7.73	.19	.33	11.89	7.93	5.95	4.76	28.76
14	7.18	.18	.38	10.26	6.84	5.13	4.10	24.80
15	6.70	.17	.44	8.93	5.96	4.47	3.57	21.67
16	6.28	.16	.50	7.85	5.23	3.93	3.14	18.98
17	5.91	.15	.56	6.95	4.64	3.48	2.78	16.82
18	5.59	.14	.63	6.21	4.14	3.11	2.48	15.00
19	5.29	.13	.70	5.57	3.71	2.78	2.23	13.46
20	5.03	.12	.78	5.03	3.35	2.52	2.01	12.15
21	4.79	.12	.86	4.56	3.04	2.28	1.82	11.02
22	4.57	.11	.94	4.15	2.80	2.08	1.66	10.04
23	4.37	.11	1.03	3.80	2.53	1.90	1.52	9.19
24	4.19	.11	1.12	3.49	2.33	1.75	1.40	8.44
25	4.02	.10	1.22	3.22	2.14	1.61	1.29	7.76
26	3.87	.10	1.32	2.98	1.98	1.49	1.19	7.19
27	3.72	.09	1.42	2.76	1.84	1.38	1.10	6.67
28	3.59	.09	1.53	2.56	1.71	1.28	1.03	6.19
29	3.47	.08	1.64	2.39	1.60	1.20	.96	5.78
30	3.35	.08	1.76	2.23	1.49	1.12	.89	5.40
31	3.24	.07	1.88	2.09	1.39	1.05	.84	5.06

8″ STEEL I BEAMS.—No. 11.

LEAST SECTION.

Flange width, ... 4.38
Web thickness, ...41
Area in square inches, ... 8.26
Resistance, ... 21.20
Pounds per foot, ... 28.08

GREATEST SECTION.

Flange width, ... 4.57
Web thickness, ...60
Area in square inches, ... 9.78
Resistance, ... 23.23
Pounds per foot, ... 33.25

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	19.79	.37	.08	65.96	43.97	32.98	26.39	120.00
7	16.96	.32	.11	48.44	32.29	24.22	19.38	87.16
8	14.84	.28	.14	37.12	24.74	18.55	14.84	67.50
9	13.19	.25	.18	29.30	19.54	14.65	11.72	53.33
10	11.87	.22	.22	23.74	15.83	11.87	9.49	43.20
11	10.79	.20	.26	19.62	13.08	9.80	7.85	35.70
12	9.89	.18	.31	16.48	10.99	8.24	6.59	30.00
13	9.15	.17	.37	14.05	9.37	7.02	5.62	25.56
14	8.48	.16	.43	12.12	8.08	6.06	4.85	22.04
15	7.92	.15	.49	10.56	7.04	5.28	4.22	19.20
16	7.42	.14	.56	9.28	6.18	4.63	3.71	16.88
17	6.98	.13	.64	8.22	5.47	4.10	3.29	14.95
18	6.60	.12	.71	7.33	4.88	3.67	2.93	13.33
19	6.25	.12	.79	6.58	4.39	3.29	2.63	11.97
20	5.94	.11	.88	5.94	3.96	2.98	2.38	10.80
21	5.65	.11	.97	5.39	3.59	2.69	2.15	9.80
22	5.40	.10	1.07	4.91	3.28	2.46	1.97	8.93
23	5.16	.10	1.16	4.49	2.99	2.24	1.80	8.17
24	4.94	.10	1.27	4.12	2.75	2.06	1.64	7.50
25	4.75	.09	1.38	3.80	2.53	1.90	1.52	6.91
26	4.56	.09	1.49	3.50	2.34	1.75	1.40	6.39
27	4.39	.08	1.61	3.25	2.17	1.63	1.30	5.93
28	4.24	.08	1.73	3.02	2.02	1.51	1.21	5.51
29	4.09	.07	1.85	2.82	1.88	1.41	1.13	5.14

8″ STEEL I BEAMS.—No. 12.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.00	Flange width,	4.20
Web thickness,	.30	Web thickness,	.50
Area in square inches,	6.24	Area in square inches,	7.84
Resistance,	16.71	Resistance,	18.84
Pounds per foot,	21.22	Pounds per foot,	26.65

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	13.43	.37	.08	45.60	30.40	22.80	18.24	120.00
7	13.37	.32	.11	38.20	25.46	19.09	15.28	87.16
8	11.70	.28	.14	29.26	19.50	14.63	11.70	67.50
9	10.39	.25	.18	23.09	15.40	11.54	9.24	53.33
10	9.36	.22	.22	18.72	12.48	9.36	7.49	43.20
11	8.51	.20	.26	15.47	10.31	7.74	6.19	35.70
12	7.80	.18	.31	13.00	8.66	6.50	5.20	30.00
13	7.20	.17	.37	11.08	7.38	5.54	4.33	25.56
14	6.68	.16	.43	9.55	6.36	4.78	3.82	22.04
15	6.24	.15	.49	8.32	5.54	4.16	3.32	19.20
16	5.84	.14	.56	7.31	4.87	3.65	2.93	16.88
17	5.51	.13	.64	6.48	4.32	3.24	2.59	14.95
18	5.20	.12	.71	5.77	3.85	2.89	2.30	13.33
19	4.92	.12	.79	5.18	3.46	2.59	2.08	11.97
20	4.68	.11	.88	4.68	3.12	2.34	1.87	10.80
21	4.45	.11	.97	4.24	2.83	2.12	1.69	9.80
22	4.25	.10	1.07	3.86	2.58	1.93	1.55	8.93
23	4.07	.10	1.16	3.54	2.36	1.76	1.42	8.17
24	3.90	.10	1.27	3.25	2.17	1.62	1.30	7.50
25	3.74	.09	1.38	3.00	1.99	1.50	1.20	6.91
26	3.60	.09	1.49	2.77	1.85	1.38	1.10	6.39
27	3.47	.09	1.61	2.57	1.72	1.28	1.03	5.93
28	3.35	.08	1.73	2.39	1.60	1.20	0.96	5.51
29	3.23	.07	1.85	2.23	1.49	1.12	0.89	5.14

8″ STEEL I BEAMS.—No. 507.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.00	Flange width,	4.14
Web thickness,	.26	Web thickness,	.40
Area in square inches,	5.08	Area in square inches,	6.20
Resistance,	13.58	Resistance,	15.06
Pounds per foot,	17.27	Pounds per foot,	21.07

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq. Foot.*	
6	10.52	.37	.08	35.07	23.38	17.53	14.03	120.00
7	10.52	.32	.11	30.06	20.00	15.03	12.00	87.16
8	9.51	.28	.14	23.78	15.85	11.89	9.51	67.50
9	8.45	.25	.18	18.78	12.52	9.39	7.51	53.33
10	7.60	.22	.22	15.20	10.13	7.60	6.08	43.20
11	6.91	.20	.26	12.56	8.38	6.28	5.03	35.70
12	6.34	.18	.31	10.57	7.04	5.28	4.23	30.00
13	5.85	.17	.37	9.00	6.00	4.50	3.60	25.56
14	5.43	.16	.43	7.76	5.17	3.88	3.10	22.04
15	5.07	.15	.49	6.76	4.51	3.39	2.70	19.20
16	4.75	.14	.56	5.94	3.96	2.97	2.38	16.88
17	4.47	.13	.64	5.26	3.51	2.63	2.10	14.95
18	4.22	.12	.71	4.69	3.13	2.34	1.88	13.33
19	4.00	.12	.79	4.21	2.80	2.10	1.68	11.97
20	3.80	.11	.88	3.80	2.53	1.90	1.52	10.80
21	3.62	.11	.97	3.45	2.30	1.73	1.38	9.80
22	3.46	.10	1.07	3.15	2.10	1.57	1.26	8.93
23	3.31	.10	1.16	2.88	1.92	1.44	1.15	8.17
24	3.17	.10	1.27	2.64	1.76	1.32	1.06	7.50
25	3.04	.09	1.38	2.43	1.62	1.22	.97	6.91
26	2.92	.09	1.49	2.25	1.50	1.12	.90	6.39
27	2.82	.08	1.61	2.09	1.39	1.05	.84	5.93
28	2.72	.08	1.73	1.94	1.30	.97	.78	5.51
29	2.62	.07	1.85	1.80	1.20	.90	.72	5.14

7″ STEEL I BEAMS.—No. 13.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.81	Flange width,	3.87
Web thickness,	.44	Web thickness,	.50
Area in square inches,	6.68	Area in square inches,	7.10
Resistance,	14.40	Resistance,	14.89
Pounds per foot,	22.70	Pounds per foot,	24.14

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	13.44	.32	.10	44.80	30.87	22.40	17.92	105.00
7	11.52	.28	.12	32.92	21.95	16.46	13.16	77.14
8	10.08	.24	.16	25.20	16.80	12.60	10.08	59.06
9	8.96	.22	.20	19.92	13.28	9.96	7.97	46.67
10	8.06	.19	.25	16.13	10.75	8.06	6.56	37.80
11	7.33	.18	.30	13.33	8.89	6.66	5.33	31.24
12	6.72	.17	.36	11.20	7.46	5.60	4.48	26.25
13	6.20	.16	.42	9.54	6.36	4.77	3.82	22.37
14	5.76	.14	.49	8.23	5.48	4.12	3.29	19.29
15	5.38	.13	.56	7.16	4.78	3.58	2.87	16.80
16	5.04	.12	.64	6.30	4.20	3.15	2.52	14.77
17	4.74	.12	.72	5.58	3.72	2.79	2.23	13.08
18	4.48	.11	.81	4.97	3.31	2.48	1.99	11.67
19	4.25	.11	.91	4.48	2.98	2.24	1.79	10.47
20	4.03	.10	1.01	4.03	2.69	2.02	1.61	9.45
21	3.84	.10	1.10	3.66	2.44	1.83	1.46	8.57
22	3.66	.08	1.21	3.32	2.22	1.66	1.33	7.81
23	3.50	.08	1.32	3.05	2.03	1.52	1.22	7.15
24	3.36	.08	1.44	2.80	1.87	1.40	1.12	6.56
25	3.23	.08	1.56	2.58	1.72	1.29	1.03	6.05
26	3.10	.07	1.69	2.38	1.58	1.19	0.95	5.74
27	2.99	.07	1.82	2.21	1.48	1.11	0.89	5.19
28	2.88	.07	1.96	2.05	1.37	1.03	0.83	4.82
29	2.78	.07	2.11	1.92	1.28	0.96	0.77	4.49

7″ STEEL I BEAMS.—No. 14.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.61	Flange width,	3.81
Web thickness,	.24	Web thickness,	.44
Area in square inches,	5.26	Area in square inches,	6.66
Resistance,	12.74	Resistance,	14.37
Pounds per foot,	17.88	Pounds per foot,	22.64

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{5}{16}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	8.84	.32	.10	30.00	20.00	15.00	12.00	105.00
7	8.84	.28	.12	25.72	17.15	12.86	10.28	77.14
8	8.84	.24	.16	22.30	14.86	11.15	8.92	59.06
9	7.93	.22	.20	17.63	11.75	8.81	7.06	46.67
10	7.14	.19	.25	14.28	9.52	7.14	5.71	37.80
11	6.48	.18	.30	11.78	7.86	5.89	4.72	31.24
12	5.94	.17	.36	9.90	6.60	4.95	3.96	26.25
13	5.48	.16	.42	8.44	5.63	4.20	3.37	22.37
14	5.10	.14	.49	7.28	4.86	3.64	2.92	19.29
15	4.75	.13	.56	6.34	4.22	3.17	2.53	16.80
16	4.46	.12	.64	5.58	3.72	2.79	2.23	14.77
17	4.20	.12	.72	4.94	3.30	2.47	1.98	13.08
18	3.96	.11	.81	4.40	2.93	2.20	1.76	11.67
19	3.76	.11	.91	3.95	2.64	1.98	1.58	10.47
20	3.56	.10	1.01	3.56	2.38	1.79	1.43	9.45
21	3.40	.10	1.10	3.24	2.16	1.62	1.30	8.57
22	3.24	.08	1.21	2.94	1.97	1.47	1.18	7.81
23	3.10	.08	1.32	2.69	1.80	1.34	1.08	7.15
24	2.98	.08	1.44	2.48	1.66	1.24	0.99	6.56
25	2.86	.08	1.56	2.28	1.52	1.14	0.91	6.05
26	2.75	.07	1.69	2.11	1.40	1.06	0.84	5.74
27	2.64	.07	1.82	1.96	1.30	0.98	0.78	5.19
28	2.54	.07	1.96	1.81	1.21	0.91	0.72	4.82
29	2.46	.07	2.11	1.69	1.13	0.85	0.68	4.49

7″ STEEL I BEAMS.—No. 505.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.75	Flange width,	3.89
Web thickness,	.24	Web thickness,	.38
Area in square inches,	4.25	Area in square inches,	5.23
Resistance,	10.07	Resistance,	11.21
Pounds per foot,	14.44	Pounds per foot,	17.78

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	8.84	.32	.10	30.00	20.00	15.00	12.00	105.00
7	8.06	.28	.12	23.03	15.35	11.52	9.21	77.14
8	7.05	.24	.16	17.63	11.75	8.82	7.05	59.06
9	6.27	.22	.20	13.93	9.29	6.97	5.57	46.67
10	5.64	.19	.25	11.28	7.52	5.64	4.51	37.80
11	5.13	.18	.30	9.33	6.22	4.67	3.73	31.24
12	4.70	.17	.36	7.83	5.22	3.92	3.13	26.25
13	4.34	.16	.42	6.68	4.45	3.34	2.67	22.37
14	4.03	.14	.49	5.76	3.84	2.88	2.30	19.29
15	3.76	.13	.56	5.01	3.34	2.51	2.00	16.80
16	3.52	.12	.64	4.40	2.93	2.20	1.76	14.77
17	3.32	.12	.72	3.91	2.60	1.95	1.56	13.08
18	3.13	.11	.81	3.48	2.32	1.74	1.39	11.67
19	2.97	.11	.91	3.13	2.08	1.56	1.25	10.47
20	2.82	.10	1.01	2.82	1.88	1.41	1.13	9.45
21	2.69	.10	1.10	2.56	1.71	1.28	1.02	8.57
22	2.56	.08	1.21	2.33	1.55	1.16	0.93	7.81
23	2.45	.08	1.32	2.13	1.40	1.07	0.85	7.15
24	2.35	.08	1.44	1.96	1.30	0.98	0.78	6.56
25	2.26	.08	1.56	1.81	1.20	0.90	0.72	6.05
26	2.17	.07	1.69	1.67	1.11	0.84	0.67	5.74
27	2.09	.07	1.82	1.55	1.03	0.78	0.62	5.19
28	2.01	.07	1.96	1.44	0.96	0.72	0.57	4.82
29	1.94	.07	2.11	1.34	0.89	0.67	0.53	4.49

6″ STEEL I BEAMS.—No. 23.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	5.25	Flange width,	5.50
Web thickness,	.63	Web thickness,	.88
Area in square inches,	11.79	Area in square inches,	13.29
Resistance,	21.36	Resistance,	22.86
Pounds per foot,	40.08	Pounds per foot,	45.19

Greatest safe load in net tons evenly distributed, including beam itself.

For a load in middle of beam, allow one-half of the tabular load.

Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	19.93	.28	.11	66.44	42.29	33.22	26.58	90.00
7	17.09	.24	.14	48.83	32.54	24.41	19.52	66.12
8	14.95	.21	.19	37.38	24.92	18.70	14.95	50.63
9	13.30	.19	.24	29.54	19.69	14.77	11.82	40.00
10	11.96	.17	.29	23.93	15.95	11.96	9.58	32.40
11	10.87	.15	.35	19.76	13.18	9.89	7.91	26.78
12	9.97	.14	.42	16.62	11.08	8.32	6.65	22.50
13	9.20	.13	.49	14.16	9.44	7.08	5.66	19.17
14	8.54	.12	.57	12.20	8.14	6.11	4.88	16.53
15	7.88	.11	.66	10.64	7.09	5.32	4.26	14.40
16	7.48	.11	.75	9.35	6.23	4.67	3.74	12.66
17	7.03	.10	.85	8.27	5.52	4.14	3.31	11.21
18	6.65	.10	.95	7.39	4.92	3.70	2.95	10.00
19	6.30	.08	1.05	6.64	4.42	3.31	2.65	8.97
20	5.98	.08	1.16	5.98	3.98	2.99	2.13	8.10
21	5.70	.08	1.28	5.42	3.62	2.71	2.17	7.35
22	5.44	.07	1.41	4.94	3.30	2.47	1.98	6.69
23	5.20	.07	1.54	4.52	3.01	2.26	1.81	6.11
24	4.98	.07	1.68	4.15	2.77	2.08	1.66	5.63
25	4.79	.07	1.82	3.83	2.56	1.92	1.54	5.18
26	4.60	.06	1.98	3.54	2.35	1.76	1.42	4.79
27	4.43	.06	2.14	3.28	2.18	1.64	1.31	4.44
28	4.27	.06	2.30	3.05	2.04	1.52	1.22	4.13
29	4.13	.06	2.47	2.84	1.90	1.43	1.14	3.85

6″ STEEL I BEAMS.—No. 24.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	4.88	Flange width,	5.13
Web thickness,	.59	Web thickness,	.75
Area in square inches,	9.27	Area in square inches,	10.77
Resistance,	17.51	Resistance,	19.01
Pounds per foot,	31.52	Pounds per foot,	36.62

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{5}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	16.34	.28	.11	54.48	36.32	27.24	21.79	90.00
7	14.00	.24	.14	40.01	26.68	20.00	16.01	66.12
8	12.25	.21	.19	30.64	20.42	15.31	12.25	50.63
9	10.90	.19	.24	24.22	16.14	12.11	9.68	40.00
10	9.80	.17	.29	19.61	13.07	9.80	7.85	32.40
11	8.92	.15	.35	16.21	10.81	8.10	6.48	26.78
12	8.17	.14	.42	13.62	9.08	6.82	5.45	22.50
13	7.55	.13	.49	11.62	7.74	5.81	4.64	19.17
14	7.01	.12	.57	10.01	6.67	5.00	4.01	16.53
15	6.54	.11	.66	8.72	5.81	4.36	3.49	14.40
16	6.13	.11	.75	7.67	5.11	3.83	3.07	12.66
17	5.77	.10	.85	6.79	4.52	3.40	2.71	11.21
18	5.45	.10	.95	6.05	4.03	3.02	2.42	10.00
19	5.16	.08	1.05	5.44	3.62	2.71	2.17	8.97
20	4.91	.08	1.16	4.91	3.28	2.45	1.97	8.10
21	4.67	.08	1.28	4.44	2.96	2.22	1.78	7.35
22	4.45	.07	1.41	4.04	2.70	2.03	1.62	6.69
23	4.26	.07	1.54	3.71	2.47	1.85	1.48	6.11
24	4.08	.07	1.68	3.40	2.27	1.70	1.36	5.63
25	3.92	.07	1.82	3.14	2.09	1.57	1.26	5.18
26	3.77	.06	1.98	2.90	1.93	1.45	1.16	4.79
27	3.64	.06	2.14	2.69	1.80	1.34	1.08	4.44
28	3.50	.06	2.30	2.51	1.67	1.25	1.00	4.13
29	3.38	.06	2.47	2.33	1.56	1.16	0.94	3.85

6″ STEEL I BEAMS.—No. 15.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.84	Flange width,	4.19
Web thickness,	.28	Web thickness,	.63
Area in square inches,	5.65	Area in square inches,	7.75
Resistance,	11.41	Resistance,	13.51
Pounds per foot,	19.21	Pounds per foot,	26.35

Greatest safe load in net tons evenly distributed, including beam itself.

For a load in middle of beam, allow one-half of the tabular load.

Deflection for centre load will be $\frac{5}{1\,0}$ of the tabular deflection.

Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	10.61	.28	.11	35.52	23.68	17.76	14.21	90.00
7	9.13	.24	.14	26.09	17.40	13.04	10.44	66.12
8	7.99	.21	.19	19.98	13.32	10.00	7.99	50.63
9	7.10	.19	.24	15.79	10.52	7.90	6.31	40.00
10	6.40	.17	.29	12.79	8.53	6.40	5.11	32.40
11	5.81	.15	.35	10.56	7.04	5.28	4.22	26.78
12	5.33	.14	.42	8.88	5.92	4.44	3.55	22.50
13	4.92	.13	.49	7.57	5.05	3.78	3.02	19.17
14	4.56	.12	.57	6.52	4.34	3.25	2.60	16.53
15	4.26	.11	.66	5.68	3.79	2.84	2.27	14.40
16	4.00	.11	.75	4.99	3.34	2.50	2.00	12.66
17	3.76	.10	.85	4.42	2.94	2.21	1.76	11.21
18	3.55	.10	.95	3.95	2.63	1.97	1.58	10.00
19	3.36	.08	1.05	3.54	2.35	1.76	1.42	8.97
20	3.19	.08	1.16	3.19	2.12	1.60	1.27	8.10
21	3.05	.08	1.28	2.90	1.93	1.45	1.16	7.35
22	2.90	.07	1.41	2.64	1.76	1.32	1.06	6.69
23	2.78	.07	1.54	2.42	1.61	1.21	.97	6.11
24	2.66	.07	1.68	2.22	1.48	1.12	.89	5.63
25	2.56	.07	1.82	2.04	1.37	1.02	.82	5.18
26	2.46	.06	1.98	1.90	1.26	.95	.76	4.79
27	2.36	.06	2.14	1.75	1.16	.88	.70	4.44
28	2.28	.06	2.30	1.63	1.08	.82	.65	4.13
29	2.21	.06	2.47	1.52	1.02	.76	.61	3.85

6″ STEEL I BEAMS.—No. 16.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.47	Flange width,	3.69
Web thickness,	.22	Web thickness,	.44
Area in square inches,	4.10	Area in square inches,	5.42
Resistance,	8.47	Resistance,	9.79
Pounds per foot,	13.93	Pounds per foot,	18.42

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	7.28	.28	.11	24.72	16.48	12.36	9.89	90.00
7	6.78	.24	.14	19.37	12.91	9.63	7.75	66.12
8	5.93	.21	.19	14.82	9.88	7.42	5.93	50.63
9	5.27	.19	.24	11.71	7.80	5.86	4.68	40.00
10	4.74	.17	.29	9.48	6.32	4.74	3.79	32.40
11	4.31	.15	.35	7.84	5.22	3.91	3.13	26.78
12	3.95	.14	.42	6.58	4.39	3.29	2.63	22.50
13	3.65	.13	.49	5.62	3.74	2.81	2.24	19.17
14	3.38	.12	.57	4.84	3.23	2.41	1.93	16.53
15	3.17	.11	.66	4.22	2.82	2.11	1.69	14.40
16	2.96	.11	.75	3.71	2.47	1.85	1.49	12.66
17	2.80	.10	.85	3.29	2.20	1.64	1.32	11.21
18	2.64	.10	.95	2.93	1.96	1.46	1.18	10.00
19	2.50	.08	1.05	2.63	1.75	1.31	1.06	8.97
20	2.38	.08	1.16	2.38	1.58	1.19	.95	8.10
21	2.26	.08	1.28	2.15	1.43	1.08	.86	7.35
22	2.16	.07	1.41	1.97	1.31	.98	.78	6.69
23	2.06	.07	1.54	1.80	1.20	.90	.72	6.11
24	1.98	.07	1.68	1.66	1.10	.83	.66	5.63
25	1.90	.07	1.82	1.51	1.01	.76	.61	5.18
26	1.82	.06	1.98	1.40	.94	.70	.56	4.79
27	1.75	.06	2.14	1.30	.86	.65	.52	4.44
28	1.69	.06	2.30	1.21	.80	.60	.48	4.13
29	1.63	.06	2.47	1.13	.76	.56	.46	3.85

6″ STEEL I BEAMS.—No. 503.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.40	Flange width,	3.56
Web thickness,	.22	Web thickness,	.38
Area in square inches,	3.51	Area in square inches,	4.47
Resistance,	7.05	Resistance,	8.01
Pounds per foot,	11.93	Pounds per foot,	15.20

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
6	6.58	.28	.11	21.93	14.62	10.97	8.77	90.00
7	5.64	.24	.14	16.11	10.74	8.06	6.45	66.12
8	4.94	.21	.19	12.35	8.23	6.18	4.94	50.63
9	4.39	.19	.24	9.76	6.50	4.88	3.90	40.00
10	3.95	.17	.29	7.90	5.27	3.95	3.16	32.40
11	3.59	.15	.35	6.53	4.35	3.27	2.25	26.78
12	3.29	.14	.42	5.48	3.66	2.74	2.19	22.50
13	3.04	.13	.49	4.68	3.12	2.34	1.87	19.17
14	2.82	.12	.57	4.03	2.69	2.02	1.61	16.53
15	2.63	.11	.66	3.51	2.34	1.75	1.40	14.40
16	2.47	.11	.75	3.10	2.06	1.55	1.24	12.66
17	2.32	.10	.85	2.73	1.82	1.37	1.09	11.21
18	2.19	.10	.95	2.43	1.60	1.22	.97	10.00
19	2.08	.08	1.05	2.19	1.46	1.10	.88	8.97
20	1.97	.08	1.16	1.97	1.31	.99	.79	8.10
21	1.88	.08	1.28	1.79	1.19	.90	.72	7.35
22	1.79	.07	1.41	1.63	1.08	.82	.65	6.69
23	1.72	.07	1.54	1.50	1.00	.75	.60	6.11
24	1.65	.07	1.68	1.38	.92	.69	.55	5.63
25	1.58	.07	1.82	1.27	.84	.63	.51	5.18
26	1.52	.06	1.98	1.17	.78	.59	.47	4.79
27	1.46	.06	2.14	1.08	.72	.54	.43	4.44
28	1.41	.06	2.30	1.01	.67	.51	.40	4.13
29	1.36	.06	2.47	.94	.63	.47	.38	3.85

5″ STEEL I BEAMS.—No. 17.

LEAST SECTION		GREATEST SECTION.	
Flange width,	3.06	Flange width,	3.17
Web thickness,	.26	Web thickness,	.37
Area in square inches,	3.03	Area in square inches,	3.58
Resistance,	4.88	Resistance,	5.34
Pounds per foot,	10.30	Pounds per foot	12.17

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 Pounds per Sq. Foot.	*150 Pounds per Sq. Foot.*	*200 Pounds per Sq. Foot.*	*250 Pounds per Sq Foot.*	
4	6.83	.35	.06	34.14	22.76	17.08	13.66	168.75
5	5.46	.28	.08	21.84	14.56	10.92	8.74	108.00
6	4.56	.23	.12	15.20	10.13	7.60	6.08	75.00
7	3.90	.20	.17	11.15	7.43	5.57	4.45	55.10
8	3.42	.18	.23	8.56	5.70	4.27	3.42	42.19
9	3.04	.16	.29	6.74	4.50	3.37	2.70	33.33
10	2.74	.14	.35	5.47	3.65	2.74	2.18	27.00
11	2.48	.13	.42	4.53	3.01	2.26	1.81	22.31
12	2.28	.12	.50	3.80	2.53	1.90	1.52	18.75
13	2.10	.11	.59	3.23	2.15	1.62	1.30	15.98
14	1.96	.10	.68	2.80	1.86	1.39	1.12	13.77
15	1.82	.09	.79	2.44	1.62	1.21	0.97	12.00
16	1.70	.08	.90	2.14	1.42	1.07	0.85	10.55
17	1.61	.08	1.02	1.90	1.26	0.95	0.76	9.34
18	1.52	.07	1.14	1.69	1.13	0.85	0.67	8.33
19	1.44	.07	1.27	1.51	1.01	0.76	0.61	7.48
20	1.37	.07	1.40	1.37	0.91	0.68	0.55	6.75
21	1.30	.07	1.55	1.24	0.83	0.61	0.49	6.12
22	1.24	.06	1.69	1.13	0.74	0.56	0.44	5.58
23	1.19	.06	1.86	1.03	0.68	0.52	0.41	5.10
24	1.14	.06	2.03	.95	0.64	0.47	0.37	4.69
25	1.09	.06	2.20	.88	0.59	0.43	0.35	4.32
26	1.04	.05	2.36	.80	0.54	0.40	0.32	3.99
27	1.01	.05	2.54	.74	0.49	0.37	0.30	3.70

5″ STEEL I BEAMS.—No. 18.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	3.00	Flange width,	3.17
Web thickness,	.20	Web thickness,	.37
Area in square inches,	2.73	Area in square inches,	3.58
Resistance,	4.63	Resistance,	5.34
Pounds per foot,	9.28	Pounds per foot,	12.17

Greatest safe load in net tons evenly distributed, including beam itself.
For a load in middle of beam, allow one-half of the tabular load.
Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.
Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
4	5.82	.35	.06	29.10	19.40	14.55	11.64	168.75
5	5.19	.28	.08	20.76	13.84	10.38	8.30	108.00
6	4.32	.23	.12	14.40	9.60	7.20	5.76	75.00
7	3.70	.20	.17	10.57	7.05	5.29	4.23	55.10
8	3.24	.18	.23	8.10	5.40	4.05	3.24	42.19
9	2.88	.16	.29	6.40	4.27	3.20	2.56	33.33
10	2.59	.14	.35	5.18	3.45	2.59	2.07	27.00
11	2.36	.13	.42	4.29	3.10	2.15	1.88	22.31
12	2.16	.12	.50	3.60	2.40	1.80	1.44	18.75
13	1.99	.11	.59	3.06	2.04	1.53	1.22	15.98
14	1.85	.10	.68	2.64	1.76	1.32	1.06	13.77
15	1.73	.09	.79	2.31	1.54	1.16	.92	12.00
16	1.62	.08	.90	2.03	1.35	1.02	.81	10.55
17	1.52	.08	1.02	1.79	1.19	.90	.72	9.34
18	1.44	.07	1.14	1.60	1.07	.80	.64	8.33
19	1.36	.07	1.27	1.43	.95	.72	.57	7.48
20	1.30	.07	1.40	1.30	.87	.65	.52	6.75
21	1.23	.07	1.55	1.17	.78	.59	.47	6.12
22	1.16	.06	1.69	1.07	.72	.54	.43	5.58
23	1.13	.06	1.86	.98	.66	.49	.39	5.10
24	1.08	.06	2.03	.90	.60	.45	.36	4.69
25	1.04	.06	2.20	.83	.55	.42	.33	4.32
26	1.00	.05	2.36	.77	.51	.38	.31	3.99
27	.96	.05	2.54	.71	.47	.36	.29	3.70

4″ STEEL I BEAMS.—No. 19.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	2.60	Flange width,	2.82
Web thickness,	.22	Web thickness,	.44
Area in square inches,	2.50	Area in square inches,	3.38
Resistance,	3.30	Resistance,	3.89
Pounds per foot,	8.50	Pounds per foot,	11.48

Greatest safe load in net tons evenly distributed, including beam itself.

For a load in middle of beam, allow one-half of the tabular load.

Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
4	4.62	.28	.07	23.10	15.40	11.56	9.24	135.00
5	3.70	.23	.11	14.78	9.85	7.39	5.92	86.40
6	3.08	.19	.16	10.23	6.85	5.14	4.12	60.00
7	2.64	.16	.22	7.55	5.03	3.77	3.01	44.08
8	2.32	.14	.28	5.80	3.86	2.89	2.32	33.75
9	2.05	.12	.36	4.56	3.04	2.28	1.82	26.67
10	1.85	.11	.44	3.70	2.46	1.85	1.48	21.60
11	1.68	.10	.53	3.06	2.04	1.52	1.22	17.85
12	1.54	.09	.64	2.56	1.70	1.28	1.02	15.00
13	1.42	.08	.74	2.18	1.45	1.09	0.88	12.78
14	1.32	.08	.86	1.88	1.26	0.95	0.76	11.02
15	1.24	.07	.98	1.64	1.10	0.83	0.66	9.60

4″ STEEL I BEAMS.—No. 20.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	2.30	Flange width,	2.45
Web thickness,	.16	Web thickness,	.31
Area in square inches,	1.84	Area in square inches,	2.44
Resistance,	2.51	Resistance,	2.91
Pounds per foot,	6.25	Pounds per foot,	8.29

4	3.52	.28	.07	17.58	11.72	8.80	7.03	135.00
5	2.81	.23	.11	11.23	7.49	5.62	4.49	86.40
6	2.34	.19	.16	7.80	5.20	3.90	3.12	60.00
7	2.00	.16	.22	5.72	3.82	2.87	2.29	44.08
8	1.75	.14	.28	4.38	2.92	2.20	1.75	33.75
9	1.56	.12	.36	3.47	2.32	1.73	1.39	26.67
10	1.40	.11	.44	2.81	1.87	1.40	1.13	21.60
11	1.27	.10	.53	2.32	1.54	1.15	.92	17.85
12	1.18	.09	.64	1.96	1.31	.98	.78	15.00
13	1.08	.08	.74	1.66	1.10	.83	.66	12.78
14	1.01	.08	.86	1.44	.96	.72	.58	11.02
15	.94	.07	.98	1.25	.83	.62	.50	9.60

3″ STEEL I BEAMS.—No. 21.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	2.40	Flange width,	2.62
Web thickness,	.22	Web thickness,	.44
Area in square inches,	2.06	Area in square inches,	2.72
Resistance,	1.99	Resistance,	2.32
Pounds per foot,	7.00	Pounds per foot,	9.24

Greatest safe load in net tons evenly distributed, including beam itself.

For a load in middle of beam, allow one-half of the tabular load.

Deflection for centre load will be $\frac{8}{10}$ of the tabular deflection.

Figures in small type denote cases where deflection is excessive.

Distance Between Supports in Feet.	*Greatest Safe Load in Net Tons for Least Section.*	*Addition to Safe Load for Each Pound per Foot Increase.*	*Deflection in Inches.*	*Greatest Distance in Feet Between Centres of Beams of Least Section for Distributed Loads as Below.*				*Divide by Load per Sq. Foot and Add to Corresponding Distance for Each Pound per Foot Increase of Beam.*
				100 *Pounds per Sq. Foot.*	150 *Pounds per Sq. Foot.*	200 *Pounds per Sq. Foot.*	250 *Pounds per Sq. Foot.*	
4	2.78	.22	.09	13.92	9.28	6.96	5.57	101.25
5	2.23	.17	.14	8.93	5.95	4.46	3.58	64.80
6	1.86	.14	.21	6.20	4.13	3.10	2.48	45.00
7	1.60	.12	.29	4.56	3.04	2.28	1.82	33.15
8	1.39	.11	.37	3.48	2.32	1.74	1.39	25.31
9	1.24	.10	.47	2.75	1.84	1.37	1.10	20.00
10	1.12	.08	.59	2.23	1.49	1.12	.89	16.20
11	1.01	.07	.71	1.84	1.22	.91	.73	13.39
12	.92	.07	.85	1.54	1.03	.77	.61	11.25
13	.85	.06	1.00	1.31	.88	.66	.53	9.59
14	.79	.06	1.15	1.13	.76	.56	.46	8.27
15	.74	.06	1.32	1.00	.66	.49	.40	7.20

3″ STEEL I BEAMS.—No. 22.

LEAST SECTION.		GREATEST SECTION.	
Flange width,	2.20	Flange width,	2.35
Web thickness,	.16	Web thickness,	.31
Area in square inches,	1.58	Area in square inches,	2.03
Resistance,	1.61	Resistance,	1.83
Pounds per foot,	5.37	Pounds per foot,	6.90

4	2.26	.22	.09	11.28	7.52	5.64	4.51	101.25
5	1.80	.17	.14	7.20	4.80	3.60	2.88	64.80
6	1.50	.14	.21	5.00	3.34	2.50	2.00	45.00
7	1.28	.12	.29	3.67	2.45	1.84	1.46	33.15
8	1.13	.11	.37	2.82	1.88	1.42	1.13	25.31
9	1.00	.10	.47	2.21	1.48	1.10	.89	20.00
10	.90	.08	.59	1.80	1.20	.90	.72	16.20
11	.82	.07	.71	1.49	.98	.74	.59	13.39
12	.76	.07	.85	1.26	.84	.64	.50	11.25
13	.70	.06	1.00	1.07	.71	.54	.43	9.59
14	.65	.06	1.15	.92	.61	.47	.37	8.27
15	.60	.06	1.32	.80	.53	.40	.32	7.20

PENCOYD IRON CHANNELS.

Greatest safe distributed load in net tons for least section.
For increased sections use coefficient of fifth column.
For centre loads take half of table.

Number of Section.	Size in Inches.	Weight in Pounds per Foot.	Coefficient for Safe Load Distributed.	Add to Coefficient for Each Increase of a Pound per Foot.	Length of Span in Feet.				
					4	6	8	10	12
30	15	47.03	274.77	3.50				27.48	22.89
								.10	.14
53	15	35.33	223.02	3.50				22.30	18.58
								.10	.14
55	13	29.47	158.84	3.03				15.88	13.23
								.11	.16
31	12	29.70	143.37	2.80				14.32	11.94
								.12	.17
32	12	20.07	98.05	2.80				9.81	8.17
								.12	.17
427	12	20.90	105.53	2.80				10.55	8.78
								.12	.17
34	10	20.47	84.23	2.33				8.42	7.01
								.15	.21
35	10	16.07	67.95	2.33				6.80	5.66
								.15	.21
36	9	17.23	63.45	2.10		10.57	7.93	6.35	5.28
						.06	.10	.16	.23
37	9	12.70	47.24	2.10		7.87	5.91	4.72	3.94
						.06	.10	.16	.23
418	8	13.50	46.25	1.87		7.70	5.78	4.63	3.85
						.07	.12	.18	.26
419	8	10.73	35.80	1.87		5.96	4.47	3.58	2.98
						.07	.12	.18	.26
40	7	13.70	39.66	1.63		6.61	4.95	3.97	3.30
						.08	.13	.21	.30
41	7	8.23	25.11	1.63		4.18	3.13	2.51	2.09
						.08	.13	.21	.30
42	6	10.73	27.63	1.40	6.90	4.60	3.45	2.76	2.30
					.04	.09	.15	.24	.35
44	6	7.70	19.26	1.40	4.81	3.21	2.41	1.93	1.61
					.04	.09	.15	.24	.35
412	5	8.23	17.54	1.16	4.38	2.92	2.19	1.75	1.46
					.05	.11	.19	.29	.42
47	4	7.20	11.84	0.93	2.96	1.97	1.48	1.18	0.98
					.06	.13	.23	.36	.52
48	4	5.50	9.31	0.93	2.32	1.55	1.16	0.93	0.77
					.06	.13	.23	.36	.52
49	3	5.10	6.35	0.70	1.58	1.05	0.80	0.64	0.53
					.08	.17	.31	.49	.70

PENCOYD IRON CHANNELS.

Figures under loads in fine type denote corresponding deflections in inches. For half the load in centre this deflection will be reduced one-fifth. For spans below black line the deflection is excessive.

Length of Span in Feet.									*Size in Inches.*
14	16	18	20	22	24	26	28	30	
19.62 .19	17.17 .25	15.27 .31	13.74 .39	12.49 .47	11.44 .55	10.57 .66	9.81 .76	9.16 .87	15
15.93 .19	13.93 .25	12.39 .31	11.15 .39	10.14 .47	9.29 .55	8.58 .66	7.96 .76	7.43 .87	15
11.34 .22	9.92 .29	8.82 .36	7.94 .45	7.22 .55	6.61 .65	6.11 .76	5.67 .81	5.29 1.01	13
10.24 .24	8.96 .31	7.97 .39	7.17 .49	6.52 .59	5.97 .70	5.51 .82	5.12 .95	4.78 1.10	12
7.00 .24	6.12 .31	5.45 .39	4.91 .49	4.46 .59	4.08 .70	3.77 .82	3.50 .95	3.27 1.10	12
7.53 .24	6.59 .31	5.86 .39	5.27 .49	4.80 .59	4.39 .70	4.06 .82	3.76 .95	3.52 1.10	12
6.01 .29	5.26 .37	4.68 .47	4.21 .58	3.83 .71	3.50 .84	3.24 .99	3.00 1.14	2.80 1.31	10
4.85 .29	4.24 .37	3.78 .47	3.40 .58	3.09 .71	2.83 .84	2.61 .99	2.42 1.14	2.26 1.31	10
4.53 .32	3.96 .41	3.53 .53	3.17 .65	2.88 .79	2.64 .94	2.44 1.10	2.26 1.27	2.12 1.47	9
3.37 .32	2.95 .41	2.62 .53	2.36 .65	2.15 .79	1.97 .94	1.82 1.10	1.68 1.27	1.57 1.47	9
3.30 .35	2.89 .47	2.57 .59	2.31 .73	2.10 .88	1.93 1.05	1.78 1.23	1.65 1.42	1.54 1.63	8
2.55 .35	2.23 .47	1.99 .59	1.79 .73	1.63 .88	1.49 1.05	1.37 1.23	1.27 1.42	1.19 1.63	8
2.83 .41	2.47 .53	2.21 .68	1.98 .83	1.80 1.00	1.65 1.20	1.53 1.42	1.41 1.63	1.32 1.87	7
1.79 .41	1.56 .53	1.40 .68	1.25 .83	1.14 1.00	1.04 1.20	0.97 1.42	0.89 1.63	0.83 1.87	7
1.97 .48	1.72 .62	1.54 .79	1.38 .97	1.26 1.19	1.15 1.40	1.06 1.65	0.98 1.90	0.92 2.19	6
1.37 .48	1.20 .62	1.07 .79	0.96 .97	0.88 1.19	0.80 1.40	0.74 1.65	0.68 1.90	0.64 2.19	6
1.25 .57	1.09 .74	0.97 .94	0.87 1.16	0.80 1.42	0.73 1.68	0.67 1.96	0.62 2.27	0.58 2.61	5
0.84 .71	0.74 .93	0.66 1.19	0.59 1.45	0.54 1.77	0.49 2.10	0.45 2.46	0.42 2.85	0.39 3.27	4
0.66 .71	0.58 .93	0.52 1.19	0.46 1.45	0.42 1.77	0.39 2.10	0.36 2.46	0.33 2.85	0.31 3.27	4
0.45 .96	0.40 1.26	0.35 1.57	0.32 1.97	0.29 2.36	0.26 2.76	0.24 3.24	0.22 3.70	0.21 4.36	3

PENCOYD STEEL CHANNELS.

Greatest safe distributed load in net tons for least section.
For increased sections use coefficient of fifth column.
For centre loads take half of table.

Number of Section.	Size in Inches.	Weight in Pounds per Foot.	Coefficient for Safe Load Distributed.	Add to Coefficient for Each Increase of a Pound per Foot.	Length of Span in Feet.				
					4	6	8	10	12
30	15	48.00	329.72	3.50				32.97	27.47
								.12	.17
53	15	36.00	267.62	3.50				26.76	22.30
								.12	.17
55	13	30.10	190.61	3.03				19.06	15.88
								.14	.19
31	12	30.30	172.04	2.80				17.20	14.33
								.15	.21
32	12	20.50	117.66	2.80				11.77	9.80
								.15	.21
427	12	21.30	126.64	2.80				12.64	10.55
								.15	.21
34	10	20.90	101.08	2.33				10.11	8.42
								.17	.25
35	10	16.40	81.54	2.33				8.15	6.80
								.17	.25
36	9	17.60	76.14	2.10		12.69	9.52	7.61	6.34
						.07	.12	.19	.28
37	9	13.00	56.69	2.10		9.45	7.08	5.67	4.72
						.07	.12	.19	.28
418	8	13.80	55.50	1.87		9.25	6.93	5.55	4.62
						.08	.14	.22	.32
419	8	11.00	42.96	1.87		7.16	5.37	4.30	3.58
						.08	.14	.22	.32
40	7	14.00	47.59	1.63		7.93	5.95	4.76	3.96
						.09	.16	.25	.36
41	7	8.40	30.13	1.63		5.02	3.76	3.01	2.51
						.09	.16	.25	.36
417	7	9.00	30.41	1.63		5.06	3.80	3.04	2.53
						.09	.16	.25	.36
42	6	11.00	33.16	1.40	8.29	5.52	4.15	3.32	2.76
					.05	.10	.19	.29	.42
44	6	7.90	23.11	1.40	5.78	3.85	2.88	2.31	1.92
					.05	.10	.19	.29	.42
415	6	7.50	21.96	1.40	5.49	3.66	2.74	2.20	1.83
					.05	.10	.19	.29	.42
412	5	8.40	21.05	1.16	5.26	3.51	2.63	2.11	1.75
					.06	.13	.22	.35	.50
413	5	6.12	15.07	1.16	3.76	2.51	1.87	1.51	1.25
					.06	.13	.22	.35	.50
47	4	7.30	14.11	0.93	3.53	2.35	1.76	1.41	1.17
					.07	.16	.28	.44	.63
48	4	5.60	11.17	0.93	2.79	1.80	1.39	1.12	0.93
					.07	.16	.28	.44	.63
411	4	5.16	10.36	0.93	2.59	1.73	1.29	1.04	0.86
					.07	.16	.28	.44	.63
49	3	5.20	7.62	0.70	1.91	1.27	0.95	0.76	0.64
					.09	.21	.37	.58	.84

PENCOYD STEEL CHANNELS.

Figures under loads in fine type denote corresponding deflections in inches. For half the load in centre this deflection will be reduced one-fifth. For spans below black line the deflection is excessive.

Length of Span in Feet.									*Size in Inches.*
14	16	18	20	22	24	26	28	30	
23.55	20.60	18.31	16.49	14.98	13.73	12.68	11.78	10.99	15
.23	.30	.38	.47	.57	.67	.79	.91	1.05	
19.11	16.72	14.86	13.38	12.15	11.15	10.21	9.56	8.92	15
.23	.30	.38	.47	.57	.67	.79	.91	1.05	
13.62	11.91	10.58	9.53	8.66	7.94	7.33	6.81	6.35	13
.26	.35	.44	.54	.65	.78	.91	1.06	1.22	
12.29	10.75	9.55	8.60	7.82	7.17	6.61	6.15	5.73	12
.29	.37	.47	.58	.70	.84	.99	1.15	1.31	
8.40	7.35	6.53	5.88	5.30	4.90	4.52	4.20	3.92	12
.29	.37	.47	.58	.70	.84	.99	1.15	1.31	
9.05	7.91	7.03	6.33	5.75	5.27	4.87	4.53	4.22	12
.29	.37	.47	.58	.70	.84	.99	1.15	1.31	
7.22	6.31	5.61	5.05	4.59	4.21	3.85	3.61	3.36	10
.34	.45	.57	.70	.85	1.01	1.18	1.37	1.58	
5.82	5.09	4.53	4.08	3.70	3.40	3.13	2.91	2.72	10
.34	.45	.57	.70	.85	1.01	1.18	1.37	1.58	
5.44	4.76	4.23	3.81	3.46	3.17	2.93	2.73	2.54	9
.38	.50	.63	.78	.95	1.12	1.32	1.53	1.76	
4.05	3.54	3.15	2.83	2.62	2.36	2.18	2.03	1.89	9
.38	.50	.63	.78	.95	1.12	1.32	1.53	1.76	
3.96	3.47	3.08	2.78	2.52	2.31	2.13	1.98	1.85	8
.43	.56	.71	.88	1.06	1.26	1.48	1.72	1.96	
3.06	2.68	2.38	2.15	1.95	1.79	1.65	1.53	1.43	8
.43	.56	.71	.88	1.06	1.26	1.48	1.72	1.96	
3.39	2.97	2.64	2.38	2.16	1.98	1.83	1.70	1.58	7
.49	.64	.81	1.00	1.21	1.44	1.69	1.97	2.25	
2.15	1.88	1.67	1.51	1.37	1.25	1.16	1.08	1.00	7
.49	.64	.81	1.00	1.21	1.44	1.69	1.97	2.25	
2.17	1.90	1.69	1.52	1.38	1.26	1.17	1.09	1.01	7
.49	.64	.81	1.00	1.21	1.44	1.69	1.97	2.25	
2.36	2.07	1.84	1.66	1.51	1.38	1.27	1.18	1.11	6
.57	.75	.95	1.17	1.42	1.68	1.97	2.28	2.63	
1.65	1.44	1.28	1.16	1.05	0.96	0.89	0.82	0.77	6
.57	.75	.95	1.17	1.42	1.68	1.97	2.28	2.63	
1.56	1.37	1.22	1.10	1.00	0.92	0.84	0.78	0.73	6
.57	.75	.95	1.17	1.42	1.68	1.97	2.28	2.63	
1.50	1.31	1.17	1.05	0.95	0.88	0.80	0.75	0.70	5
.68	.89	1.13	1.40	1.69	2.03	2.34	2.75	3.14	
1.07	0.94	0.83	0.75	0.68	0.63	0.57	0.54	0.50	5
.68	.89	1.13	1.40	1.69	2.03	2.34	2.75	3.14	
1.00	0.88	0.78	0.71	0.64	0.59	0.54	0.50	0.47	4
.86	1.13	1.41	1.76	2.12	2.52	2.97	3.43	3.92	
0.80	0.70	0.62	0.56	0.51	0.46	0.43	0.40	0.37	4
.86	1.13	1.41	1.76	2.12	2.52	2.97	3.43	3.92	
0.74	0.65	0.57	0.52	0.47	0.43	0.40	0.37	0.34	4
.86	1.13	1.41	1.76	2.12	2.50	2.97	3.43	3.92	
0.54	0.47	0.42	0.38	0.34	0.32	0.29	0.27	0.25	3
1.14	1.48	1.88	2.34	2.78	3.40	3.92	4.55	5.19	

PENCOYD IRON DECK BEAMS.

Greatest safe distributed load in net tons for least section.
For increased sections use coefficient of fifth column.
For centre loads take half of table.

Number of Section.	Size in Inches.	Weight in Pounds per Foot.	Coefficient for Safe Load Distributed.	Add to Coefficient for Each Increase of a Pound per Foot.	Length of Span in Feet.				
					4	6	8	10	12
69	11½	35.14	155.83	2.66		25.97 .01	19.48 .08	15.58 .13	12.99 .18
62	10	27.56	112.70	2.33		18.78 .05	14.09 .09	11.27 .15	9.39 .21
63	9	24.20	87.91	2.10		14.65 .06	10.98 .10	8.79 .16	7.33 .23
64	8	20.56	67.27	1.87		11.21 .07	8.41 .12	6.73 .18	5.61 .26
65	7	17.53	49.39	1.63	12.34 .03	8.23 .08	6.17 .13	4.94 .21	4.12 .31
66	6	14.06	34.14	1.40	8.54 .04	5.69 .09	4.27 .16	3.41 .24	2.85 .35
67	5	11.30	22.47	1.67	5.62 .05	3.75 .10	2.81 .19	2.25 .29	1.87 .42

STEEL DECK BEAMS.

69	11½	35.84	187.10	2.66		31.18 .04	23.39 .10	18.71 .15	15.59 .22
62	10	28.12	135.24	2.33	33.81 .03	22.54 .06	16.91 .11	13.52 .18	11.27 .25
63	9	24.68	105.49	2.10	26.37 .03	17.58 .07	13.19 .12	10.55 .19	8.79 .28
64	8	20.98	80.72	1.87	20.18 .03	13.45 .08	10.09 .14	8.07 .22	6.73 .32
65	7	17.88	59.27	1.63	14.82 .04	9.88 .09	74.08 .16	5.93 .25	4.94 .36
66	6	14.35	40.97	1.40	10.24 .05	6.83 .10	5.12 .19	4.10 .29	3.41 .43
67	5	11.53	26.96	1.67	6.74 .06	4.49 .13	3.37 .22	2.70 .35	2.25 .50

PENCOYD IRON DECK BEAMS.

Figures under loads in fine type denote corresponding deflections in inches. For half the load in centre this deflection will be reduced one-fifth. For spans below black line the deflection is excessive.

Length of Span in Feet.									*Size in Inches.*
14	16	18	20	22	24	26	28	30	
11.13 .25	9.74 .33	8.66 .41	7.79 .51	7.08 .62	6.49 .74	5.99 .86	5.57 1.00	5.19 1.15	11½
8.05 .29	7.04 .37	6.26 .46	5.64 .59	5.12 .71	4.70 .84	4.33 .98	4.03 1.15	3.76 1.32	10
6.28 .33	5.49 .42	4.88 .53	4.40 .65	4.00 .79	3.66 .94	3.38 1.10	3.14 1.27	2.93 1.46	9
4.81 .36	4.20 .47	3.74 .59	3.63 .79	3.06 .88	2.80 1.05	2.59 1.24	2.40 1.43	2.24 1.64	8
3.53 .41	3.09 .58	2.74 .68	2.47 .84	2.25 1.01	2.06 1.20	1.90 1.41	1.76 1.59	1.65 1.88	7
2.44 .48	2.13 .62	1.90 .79	1.71 .97	1.55 1.17	1.42 1.40	1.31 1.64	1.22 1.91	1.14 2.19	6
1.61 .57	1.40 .75	1.25 .95	1.12 1.18	1.02 1.41	0.94 1.69	0.86 1.97	0.80 2.29	0.75 2.64	5

STEEL DECK BEAMS.

13.36 .30	11.69 .39	10.40 .50	9.36 .61	8.50 .74	7.80 .88	7.20 1.04	6.68 1.20	6.24 1.38	11½
9.66 .34	8.45 .45	7.51 .57	6.76 .70	6.15 .85	5.64 1.01	5.20 1.19	4.83 1.38	4.51 1.58	10
7.53 .38	6.59 .50	5.86 .63	5.27 .78	4.80 .95	4.39 1.12	4.06 1.32	3.77 1.53	3.52 1.76	9
5.77 .43	5.05 .56	4.48 .71	4.04 .88	3.67 1.06	3.63 1.30	3.10 1.48	2.88 1.72	2.69 1.98	8
4.23 .49	3.70 .64	3.29 .81	2.96 1.00	2.69 1.21	2.47 1.44	2.24 1.66	2.12 1.97	1.98 2.26	7
2.93 .57	2.56 .75	2.28 .83	2.05 1.17	1.86 1.41	1.71 1.68	1.58 1.98	1.46 2.28	1.37 2.63	6
1.93 .69	1.69 .90	1.50 1.14	1.35 1.41	1.23 1.70	1.12 2.02	1.03 2.36	0.96 2.74	0.90 3.16	5

PENCOYD IRON Z BARS.

Greatest safe load distributed in net tons for least section.
For increased sections use coefficient of fifth column.
For centre loads take half of table.

Number of Section.	Size in Inches.	Weight in Pounds per Foot.	Coefficient for Safe Load Distributed.	Add to Coefficient for Each Increase of a Pound per Foot.	Length of Span in Feet.				
					4	6	8	10	12
220	3	6.47	8.72	0.70	2.18 .08	1.45 .17	1.09 .31	.872 .49	.727 .70
221	3	10.93	13.06	0.70	3.26 .08	2.18 .17	1.63 .31	1.31 .49	1.09 .70
222	4	7.73	13.90	0.93	3.47 .06	2.32 .13	1.74 .23	1.39 .37	1.16 .53
223	4	13.20	21.93	0.93	5.48 .06	3.65 .13	2.74 .23	2.19 .37	1.83 .53
224	4	18.43	28.28	0.93	7.07 .06	4.71 .13	3.53 .23	2.83 .37	2.36 .53
225	5	11.20	24.54	1.16	6.13 .05	4.09 .10	3.07 .19	2.45 .29	2.04 .42
226	5	17.43	35.51	1.16	8.88 .05	5.92 .10	4.44 .19	3.55 .29	2.96 .42
227	5	23.20	44.19	1.16	11.05 .05	7.36 .10	5.52 .19	4.42 .29	3.68 .42
228	6	15.30	39.38	1.40	9.84 .04	6.56 .09	4.92 .16	3.94 .24	3.28 .35
229	6	22.27	53.90	1.40	13.47 .04	8.98 .09	6.74 .16	5.39 .24	4.49 .35
230	6	28.80	65.52	1.40	16.38 .04	10.92 .09	8.19 .16	6.55 .24	5.46 .35

STEEL Z BARS.

220	3	6.60	10.46	0.70	2.61 .09	1.74 .21	1.31 .37	1.05 .59	.872 .84
221	3	11.15	15.67	0.70	3.92 .09	2.61 .21	1.96 .37	1.57 .59	1.30 .84
222	4	7.88	16.68	0.93	4.17 .07	2.78 .16	2.08 .28	1.67 .44	1.39 .63
223	4	13.46	26.32	0.93	6.58 .07	4.39 .16	3.29 .28	2.63 .44	2.20 .63
224	4	18.80	33.94	0.93	8.48 .07	5.66 .16	4.24 .28	3.39 .44	2.83 .63
225	5	11.42	29.45	1.16	7.36 .06	4.91 .13	3.68 .22	2.94 .35	2.45 .50
226	5	17.78	42.61	1.16	10.65 .06	7.10 .13	5.32 .22	4.26 .35	3.55 .50
227	5	23.66	53.02	1.16	13.25 .06	8.84 .13	6.63 .22	5.30 .35	4.42 .50
228	6	15.61	47.26	1.40	11.81 .05	7.88 .10	5.91 .19	4.73 .29	3.94 .42
229	6	22.71	64.68	1.40	16.17 .05	10.78 .10	8.08 .19	6.47 .29	5.39 .42
230	6	29.37	78.62	1.40	19.65 .05	13.10 .10	9.83 .19	7.86 .29	6.55 .42

PENCOYD IRON Z BARS.

Figures under loads in fine type denote corresponding deflections in inches. For half the load in centre this deflection will be reduced one-fifth. For spans to the right of black line the deflection is excessive.

Length of Span in Feet.									*Size in Inches.*
14	16	18	20	22	24	26	28	30	
.622 .95	.545 1.24	.484 1.57	.436 1.94	.396 2.36	.363 2.81	.335 3.29	.311 3.81	.290 4.37	3
.932 .95	.816 1.24	.725 1.57	.653 1.94	.593 2.36	.544 2.81	.502 3.29	.466 3.81	.435 4.37	3
.992 .72	.869 .94	.772 1.18	.695 1.46	.631 1.77	.579 2.11	.534 2.47	.496 2.87	.463 3.29	4
1.57 .72	1.37 .94	1.22 1.18	1.10 1.46	.996 1.77	.912 2.11	.843 2.47	.783 2.87	.731 3.29	4
2.02 .72	1.77 .94	1.57 1.18	1.41 1.46	1.28 1.77	1.18 2.11	1.09 2.47	1.01 2.87	.942 3.29	4
1.75 .57	1.53 .75	1.36 .95	1.23 1.17	1.11 1.41	1.02 1.68	.943 1.98	.876 2.30	.818 2.63	5
2.54 .57	2.22 .75	1.97 .95	1.77 1.17	1.61 1.41	1.48 1.68	1.36 1.98	1.27 2.30	1.18 2.63	5
3.16 .57	2.76 .75	2.45 .95	2.21 1.17	2.01 1.41	1.84 1.68	1.70 1.98	1.58 2.30	1.47 2.63	5
2.81 .48	2.46 .62	2.19 .79	1.97 .98	1.79 1.18	1.64 1.40	1.51 1.64	1.41 1.91	1.31 2.19	6
3.85 .48	3.37 .62	2.99 .79	2.70 .98	2.45 1.18	2.24 1.40	2.07 1.64	1.92 1.91	1.80 2.19	6
4.68 .48	4.10 .62	3.64 .79	3.28 .98	2.98 1.18	2.73 1.40	2.52 1.64	2.34 1.91	2.18 2.19	6

STEEL Z BARS.

.747 1.14	.653 1.49	.581 1.88	.523 2.33	.475 2.83	.435 3.37	.402 3.95	.373 4.57	.348 5.24	3
1.12 1.14	.978 1.49	.870 1.88	.783 2.33	.712 2.83	.652 3.37	.602 3.95	.559 4.57	.518 5.24	3
1.19 .86	1.04 1.13	.926 1.42	.834 1.75	.758 2.12	.695 2.53	.641 2.96	.595 3.44	.556 3.95	4
1.88 .86	1.64 1.13	1.46 1.42	1.32 1.75	1.20 2.12	1.10 2.53	1.01 2.96	.940 3.44	.847 3.95	4
2.42 .86	2.12 1.13	1.88 1.42	1.70 1.75	1.54 2.12	1.41 2.53	1.31 2.96	1.21 3.44	1.13 3.95	4
2.10 .68	1.84 .90	1.64 1.14	1.47 1.40	1.34 1.69	1.23 2.02	1.13 2.38	1.05 2.76	.981 3.16	5
3.04 .68	2.66 .90	2.37 1.14	2.13 1.40	1.94 1.69	1.77 2.02	1.64 2.38	1.52 2.76	1.42 3.16	5
3.79 .68	3.31 .90	2.94 1.14	2.65 1.40	2.41 1.69	2.21 2.02	2.04 2.38	1.89 2.76	1.77 3.16	5
3.37 .58	2.95 .74	2.62 .95	2.36 1.18	2.15 1.42	1.97 1.68	1.81 1.97	1.69 2.29	1.57 2.63	6
4.62 .58	4.04 .74	3.59 .95	3.23 1.18	2.94 1.42	2.69 1.68	2.49 1.97	2.31 2.29	2.16 2.63	6
5.61 .58	4.92 .74	4.37 .95	3.93 1.18	3.57 1.42	3.27 1.68	3.02 1.97	2.81 2.29	2.62 2.63	6

FLOOR BEAMS OF IRON OR STEEL.

The proper spacing of beams depends on the amount and character of load and the length of span. Permissible deflection as well as positive strength must be considered. If the load is motionless, and especially if the span is small in comparison with the depth of beam, it will be safe to proportion the beams for the "greatest safe loads," as in preceding tables.

If, on the contrary, the floors are subject to vibration, or the action of moving loads, and especially if the span is great in proportion to depth of beam, it becomes necessary to consider the deflection, which may become so great as to be a source of injury to the structure. It is considered good practice to limit the deflection to $\frac{1}{30}$ of an inch per foot of span, or the total deflection not to exceed $\frac{1}{360}$ part of the span. For **I** beams subjected to the loads given in the tables, this deflection usually occurs when the depth of the beam is about $\frac{1}{27}$ of the span for iron beams, or about $\frac{1}{22}$ of the span for steel beams. The preceding tables indicate for each beam this limitation for deflection. Those in heavy type above the dark line deflect less, and those in fine type below the same line deflect more than $\frac{1}{360}$ of the span. If the spans are unusually long, it is best to reduce the deflection below this limit, and then it is best to maintain the depth of the beam not less than $\frac{1}{20}$ of the span. It has been demonstrated that the greatest mass of men that can be packed on any floor will not exceed in weight 80 lbs. per square foot. The weight of the iron beams will depend on the span, for which see a general rule farther on. If brick arches are laid between the beams, the weight of a 4″ course of brick, including the concrete filling, will be about 70 lbs. per square foot.

Within the limits of practicable spans for rolled **I** beams, it will be found that a floor is safe for a packed mass of men when the beams are not strained above the "greatest safe load" of the tables, under the following rating:

I beam joists with wooden floor = 100 lbs. per sq. foot.
Wooden floor and plastered ceilings = 110 " " "
4″ brick arches and concrete filling = 150 " " "

These figures represent the total weight of floor itself and the imposed load.

Floors proportioned as follows for given purposes will be satisfactory. The weight of the material may be included in the figures.

Character of Floor.	*Load per Square Foot.*
Lightest floors, plank covering,	100 lbs.
Lightest floors, brick arches,	150 "
Light warehouse floors,	200 "
Halls of audience,	200 "
Warehouses in which heavy pieces are moved,	250 "
Shop floors for light machinery,	250 "
Shop floors for heavy machinery,	300 to 500 lbs.

RULE FOR THE WEIGHT OF FLOOR BEAMS.

The following rule gives a close approximation to the actual weight of floor beams, when the beams are proportioned according to the tables.

$$\text{For iron } \left\{ \frac{\text{Load per sq. ft. in lbs.} \times \text{square of span in ft.}}{850 \times \text{depth of beam in ins.}} = \text{lbs. of iron beams per sq. ft. of floor.} \right.$$

or

$$\text{For steel } \left\{ \frac{\text{Load per sq. ft. in lbs.} \times \text{square of span in ft.}}{1000 \times \text{depth of beam in ins.}} = \text{lbs. of steel beams per sq. ft. of floor.} \right.$$

Example.—A floor of 16 feet span bears 200 lbs. per sq. ft., required the weight of floor beams if 12″ beams are used.

$$\frac{200 \times 256}{850 \times 12} = 5 \text{ lbs. per sq. ft. of iron beams.} \quad \Big| \quad \frac{200 \times 256}{1000 \times 12} = 4.3 \text{ lbs. per sq. ft. of steel beams.}$$

To the foregoing must be added the weight of the ends of the beams built into the supports, or a length at each end about the same as the depth of the beam. The following table gives the weights of steel and iron beams per square foot of floor, for a load of 100 lbs. per square foot, the beams, as in the preceding tables, subject to a stress of 14,000 lbs. per square inch for iron, or 16,800 lbs. for steel. For greater floor loads the weight of beams increases in direct proportion. Thus, for a floor to carry 200 lbs. per square foot, the weight of floor beams will be twice that of the table. Also, if the floor beams are proportioned for a lower fibre stress, the weight of beams will increase in inverse ratio.

Thus, if the fibre strain allowed is 12,000 lbs. per square inch, the weight of beams will be increased as 12 to 14, or **one-sixth heavier than the table.**

PENCOYD I BEAMS.

LEAST WEIGHT OF FLOOR BEAMS IN POUNDS,

For each square foot of floor, including ends at supports, based on a load of 100 pounds per square foot of floor.

For heavier loads, the weights of beams are proportionately increased.

Size of I *Beam.*	*Material.*	*Clear Span of Beams in Feet.*										
		8	10	12	14	16	18	20	22	24	26	28
15 ins.	Iron.		1.11	1.33	1.75	2.23	2.79	3.40	4.08	4.81	5.61	6.46
	Steel.		0.94	1.19	1.49	1.90	2.37	2.89	3.47	4.09	4.76	5.53
12 ins.	Iron.		1.14	1.59	2.14	2.74	3.42	4.15	5.04	5.92	6.91	7.99
	Steel.		0.97	1.35	2.00	2.32	2.90	3.55	4.33	5.06	5.88	6.73
10½ ins.	Iron.		1.22	1.72	2.28	2.95	3.69	4.53	5.43	6.43	7.51	8.67
	Steel.		1.04	1.47	1.90	2.51	3.14	3.85	4.62	5.44	6.34	7.37
10 ins.	Iron.		1.30	1.83	2.45	3.15	3.95	4.83	5.81	6.88	8.02	
	Steel.		1.09	1.59	2.06	2.55	3.32	4.13	4.89	5.78	6.75	
9 ins.	Iron.	0.92	1.38	1.96	2.62	3.38	4.24	5.20	6.25	7.40		
	Steel.	0.78	1.17	1.65	2.22	2.79	3.58	4.38	5.34	6.26		
8 ins.	Iron.	1.02	1.54	2.18	2.92	3.76	4.74	5.81	6.99	8.29		
	Steel.	0.86	1.30	1.86	2.47	3.19	4.00	4.91	5.90	7.00		
7 ins.	Iron.	1.15	1.75	2.47	3.32	4.25	5.41	6.63	8.00			
	Steel.	0.96	1.46	2.07	2.79	3.61	4.53	5.56	6.71			
6 ins.	Iron.	1.32	2.02	2.87	3.86	5.00	6.29	7.72				
	Steel.	1.12	1.71	2.42	3.26	4.22	5.31	6.51				
5 ins.	Iron.	1.58	2.40	3.41	4.59	5.10	7.49					
	Steel.	1.29	1.99	2.83	3.86	4.93	6.22					
4 ins.	Iron.	1.84	2.84	4.05	5.45							
	Steel.	1.56	2.41	3.43	4.64							
3 ins.	Iron.	2.44	3.78	5.40	7.31							
	Steel.	2.08	3.21	4.58	6.23							

The figures above the dark line are for beams and corresponding spaces with deflections less than $\frac{1}{360}$ part of the span.

FLOORING MATERIAL.

For fire-proof flooring, the space between the floor beams may be spanned with brick arches, or with hollow brick made especially for the purpose, the latter being much lighter than ordinary brick.

Arches 4 inches deep of solid brick weigh about 70 lbs. per square foot, including the concrete leveling material, and substantial floors are thus made up to 6 feet span of arch, or much greater span if the skew backs at the springing of the arch are made deeper, the rise of the arch being preferably not less than $\frac{1}{10}$ of the span. Hollow brick for floors are usually in depth about $\frac{1}{8}$ of the span, and are used up to, and even exceeding, spans of 10 feet. The weight of the latter material will vary from 20 lbs. per square foot for 3 feet spans up to 60 lbs. per square foot for spans of 10 feet. Full particulars of this construction are given by the manufacturers. For supporting brick floors the beams should be securely tied with rods to resist the lateral pressure.

TIE RODS FOR BEAMS SUPPORTING BRICK ARCHES.

The horizontal thrust of brick arches is as follows:

$\frac{1.5\ WS^2}{R}$ = pressure in lbs. per lineal foot of arch.

W = load in lbs. per square foot.

S = span of arch in feet.

R = rise in inches.

Place the tie rods as low through the webs of the beams as possible, and spaced so that the pressure of arches as obtained above will not produce a greater stress than 15,000 lbs. per square inch of the least section of the bolt.

Example.—The beams supporting an arched brick floor are 5 feet apart, and the rise of the arches is 6 inches. The total weight of floor and load equals 150 lbs. per square foot. Then $\frac{1.5 \times 150 \times 25}{6} = 937.5$ lbs. pressure per lineal foot of arch. If 1-inch screw bolts are used, which have an effective section of $\frac{6}{10}$ square inches, then $.6 \times 15{,}000 = 9{,}000$ lbs., which is the greatest load the bolt should be allowed to

sustain, and $\frac{9.000}{937.5} = 9.6$ feet = greatest distance apart of the bolts; or, in same manner, we would find 5.3 feet, if $\frac{7}{8}$-inch tie rods are used.

Ordinarily it will be found necessary to limit the spacing of the tie rods to avoid excessive bending stress on the outer beams of the floor, or to prevent this bending stress being transferred to the walls of the building.

The ability of the outer beams to resist the horizontal bending action caused by the pressure of the arches is determined as follows:

LATERAL STRENGTH OF BEAMS.

The resistance to a force acting at right angles to the web, or in the direction of the flanges, is as follows, based on fibre stresses of 14,000 lbs. for continuous iron beams, or one-fifth more for continuous steel beams:

$$W = \frac{1200\ AF}{L} \text{ for iron I beams.}$$

$$W = \frac{1440\ AF}{L} \text{ for steel I beams.}$$

$$W = \frac{1400\ AF}{L} \text{ for iron channels.}$$

$$W = \frac{1680\ AF}{L} \text{ for steel channels.}$$

$$W = \frac{2300\ AF}{L} \text{ for iron angles.}$$

$$W = \frac{2760\ AF}{L} \text{ for steel angles.}$$

W = safe load distributed in pounds, A = sectional area of beam in square inches, F = width of flange in inches, L = length between supports in feet.

Knowing the pressure per lineal foot and requiring distance L between tie bolts, the foregoing equations become $L = \sqrt{\frac{CAF}{w}}$, in which w = lateral pressure in pounds per lineal foot. C = either of the coefficients in the previous equations. If the concrete between the beams, or the brick work, was a free mass with no power to transfer the pressure over some extent, it would then be necessary not to exceed the length L as obtained above; but as in practice this is not the case, the spacing L is not imperative, but is useful as a guide.

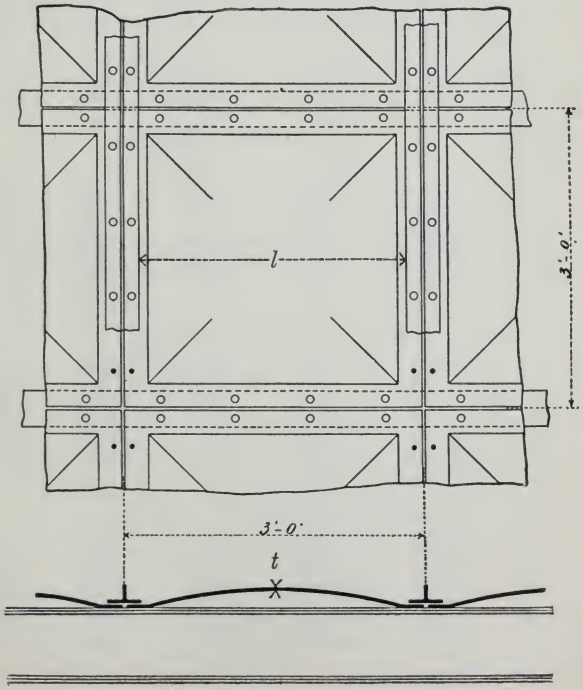
BUCKLED PLATES.

Buckled plates are usually made three feet square and from one-quarter inch to one-half inch thick, of iron or soft steel. They can be made of any desired size or thickness, or extended length, having several buckles in a single plate.

They are usually riveted to the supporting beams, and the transverse joint supported by a ⊥ or other suitable section, as indicated on the cut.

Experiment shows considerable advantage by having the edges properly secured.

Buckled plates, if used inverted—that is, with the buckle suspended—develop from three to four times as much strength as if used as shown in sketch.



The strength of buckled plates may be given by the following formula:*

$$D = \frac{100\ k\ h\ d\ -\ 0.175\ g\ l^2}{6\ h + 15\ t} \times t$$

D = total concentrated load in pounds.
g = uniform load in pounds per square foot.
h = depth of buckle in inches.
l = length of buckle in inches.
t = thickness in inches.
k = permissible stress in pounds per square inch.

If we assume $g = 120$ lbs. per square foot, and $k = 6{,}000$ lbs. per square inch, we get the following values for D, for various dimensions of plates:

TOTAL CONCENTRATED LOAD IN POUNDS, ALLOWING FOR A DISTRIBUTED LOAD OF 120 POUNDS PER SQUARE FOOT.

Size of Plate.	36 *Inches Square.*	42 *Inches Square.*	48 *Inches Square.*	54 *Inches Square.*	60 *Inches Square.*
Thickness in Inches.	2 *Inches Depth of Buckle.*				
$\frac{1}{4}$	4350	4200	4000	3800	3550
$\frac{5}{16}$	6500	6350	6100	5900	5600
$\frac{3}{8}$	9000	8800	8550	8300	8000
$\frac{7}{16}$	11700	11500	11200	10900	10600
$\frac{1}{2}$	14700	14400	14100	13800	13400
	$2\frac{1}{2}$ *Inches Depth of Buckle.*				
$\frac{1}{4}$	4600	4500	4350	4200	4000
$\frac{5}{16}$	7000	6850	6650	6450	6250
$\frac{3}{8}$	9750	9550	9350	9100	8850
$\frac{7}{16}$	12750	12550	12350	12050	11750
$\frac{1}{2}$	16050	15850	15600	15300	15000
	3 *Inches Depth of Buckle.*				
$\frac{1}{4}$	4850	4750	4600	4450	4300
$\frac{5}{16}$	7350	7250	7050	6900	6700
$\frac{3}{8}$	10250	10150	9950	9750	9500
$\frac{7}{16}$	13550	13350	13150	12950	12700
$\frac{1}{2}$	17100	16900	16700	16450	16150

* Winkler, "Querconstructionen," Vienna, 1884.

The formula shows that the concentrated load and the total uniform load are independent of l. This, of course, is only correct as long as the buckled plate is not subject to local deformations, say within the limits given in the previous table. The total uniform load a buckled plate can carry, follows from the above formula as:

$$P = 4\ k\ h\ t.$$

If we assume $k = 6{,}000$ lbs. per square inch, we get the following:

TOTAL UNIFORMLY DISTRIBUTED LOAD ON ANY SIZE PLATE OF GIVEN THICKNESS AND DEPTH OF BUCKLE.

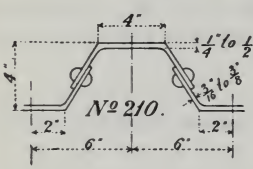
Depth of Buckle.	2 *Inches.*	2½ *Inches.*	3 *Inches.*
Thickness of Plate in Inches.	*Total Loads in Pounds.*		
¼	12000	15000	18000
5/16	15000	18750	22500
⅜	18000	22500	27000
7/16	21000	26250	31500
½	24000	30000	36000

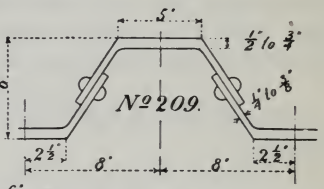
The loads in foregoing tables can be applied to plates of wrought iron or softest steel.

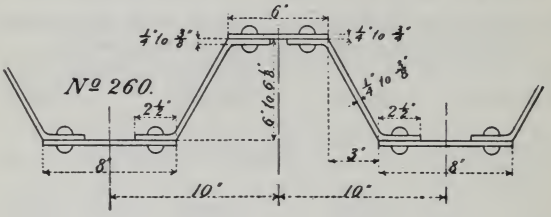
WEIGHT OF IRON BUCKLED PLATES THREE FEET SQUARE. FOR STEEL ADD 2 PER CENT.

Thickness of Plate in Inches.	*Weight of One Plate in Pounds.*	*Size and Weight of* T.	*Weight in Pounds per Square Foot of Floor.*
3/16	67	4 x 2 T = 20 lbs.	9½
¼	90	4 x 2 T = 20 "	12
5/16	112	4 x 3 T = 25 "	15
⅜	136	4 x 3½ T = 30 "	18
7/16	157	4 x 4 T = 35 "	22
½	180	4 x 4½ T = 40 "	25

Pencoyd Corrugated Flooring.







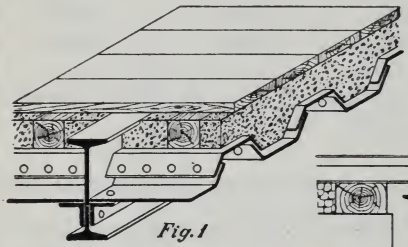


Fig. 1

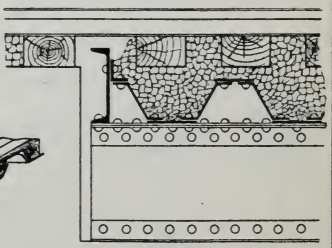


Fig. 3

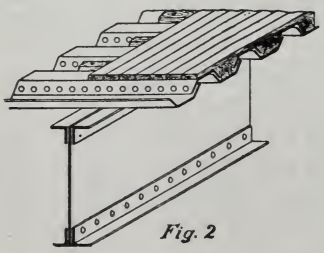


Fig. 2

PENCOYD CORRUGATED FLOORING.

Sections Nos. 209, 210 and 260 are extensively used for floors of bridges and buildings. No. 210 is generally used in buildings; Nos. 209 and 260 are used for bridge-floors.

The following table gives the weights and strength for different thicknesses of each section:

WEIGHT AND STRENGTH OF CORRUGATED FLOORING.

Section Number.	*Flange Thickness in Inches.*	*Web Thickness in Inches.*	*Weight in Pounds per Square Foot.*		*Resistance per Foot of Width.*	*Coefficient for Distributed Load in Tons, per Foot of Width.*	
			Iron.	*Steel.*		*Iron.*	*Steel.*
209	1/2	1/4	24.8		11.6	46.4	
209	9/16	3/8	27.8		13.1	52.4	
209	5/8	5/16	30.7		14.6	58.4	
209	11/16	3/8	33.6		16.1	64.4	
209	3/4	3/8	36.6		17.7	70.8	
210	1/4	3/16	14.5	14.8	4.4	17.6	22.0
210	5/16	1/4	18.0	18.4	5.5	22.0	27.5
210	3/8	9/32	21.5	21.9	6.6	26.4	33.0
210	7/16	11/32	25.0	25.5	7.7	31.0	38.7
210	1/2	3/8	28.5	29.1	8.9	35.6	44.4
260	1/4	1/4	19.6	20.0	10.5	42.0	52.5
260	3/8	1/4	23.1	23.6	13.2	52.8	66.0
260	1/2	1/4	26.6	27.1	15.9	63.6	79.5
260	5/8	1/4	30.1	30.7	18.6	74.4	93.0
260	3/8	5/16	26.0	26.5	14.3	57.2	71.5
260	1/2	5/16	29.5	30.1	17.0	68.0	85.0
260	5/8	5/16	33.0	33.7	19.7	78.8	98.5
260	3/4	5/16	36.5	37.2	22.4	89.6	112.0
260	3/8	3/8	28.8	29.4	15.3	61.2	76.5
260	1/2	3/8	32.3	32.9	18.1	72.4	90.5
260	5/8	3/8	35.8	36.5	20.9	83.6	104.5
260	3/4	3/8	39.3	40.1	23.7	94.8	118.5

The resistance and coefficients for distributed loads in tons are for each foot in width; the latter for fibre stress of 12,000 pounds for iron, and 15,000 pounds for steel, per square inch. To find the load for any span, divide the coefficient by the length of span in feet; the quotient is the distributed load in tons, which produces fibre stress on the material, as aforesaid.

The following tables give safe loads for varying thickness of each section, based on the fibre stresses aforesaid.

PENCOYD IRON CORRUGATED FLOORING.

Loads in pounds per sq. ft. of floor for a fibre stress of 12,000 lbs. per sq. inch. The figures in small type under the load in pounds are the corresponding centre deflections in inches. Those to the right of the dark line are where the centre deflection exceeds $\frac{1}{360}$ part of the span.

Section No. 210.

Weight of Material per Sq. Foot.	SPAN IN FEET.										
	6	7	8	9	10	11	12	13	14	15	16
14.5	978	718	550	435	352	291	244	208	180	156	138
	.12	.17	.22	.28	.34	.42	.50	.58	.68	.78	.88
18.0	1222	898	688	543	440	364	306	260	224	196	172
	.12	.17	.22	.28	.34	.42	.50	.58	.68	.78	.88
21.5	1467	1078	825	652	528	436	367	312	269	235	206
	.12	.17	.22	.28	.34	.42	.50	.58	.68	.78	.88
25.0	1722	1265	969	765	620	512	431	367	316	276	242
	.12	.17	.22	.28	.34	.42	.50	.58	.68	.78	.88
28.5	1978	1453	1113	879	712	588	494	421	363	316	278
	.12	.17	.22	.28	.34	.42	.50	.58	.68	.78	.88

Section No. 209.

	8	9	10	11	12	13	14	15	16	17	18
24.8	1450	1146	928	767	644	549	473	412	363	321	286
	.15	.19	.23	.28	.33	.39	.45	.52	.59	.66	.74
27.8	1638	1294	1048	866	728	620	535	470	409	363	323
	.15	.19	.23	.28	.33	.39	.45	.52	.59	.66	.74
30.7	1825	1442	1168	965	811	691	596	519	456	404	360
	.15	.19	.23	.28	.33	.39	.45	.52	.59	.66	.74
33.6	2013	1590	1288	1064	894	762	657	572	503	446	398
	.15	.19	.23	.28	.33	.39	.45	.52	.59	.66	.74
36.6	2213	1748	1416	1170	983	838	723	629	553	490	437
	.15	.19	.23	.28	.33	.39	.45	.52	.59	.66	.74

Section No. 260.

	8	9	10	11	12	13	14	15	16	17	18
19.6	1313	1037	840	694	583	497	429	373	328	291	259
	.13	.17	.21	.26	.31	.36	.42	.48	.54	.61	.69
23.1	1650	1304	1056	873	733	625	539	469	413	365	326
	.13	.16	.20	.24	.29	.34	.40	.46	.52	.59	.66
26.6	1988	1570	1272	1051	883	753	649	565	497	440	393
	.13	.16	.20	.24	.28	.33	.38	.44	.50	.57	.64
30.1	2325	1837	1488	1230	1033	880	759	661	581	515	459
	.12	.15	.19	.23	.27	.32	.37	.43	.49	.55	.62
26.0	1788	1412	1144	945	794	677	584	508	447	396	353
	.13	.17	.21	.25	.29	.34	.39	.45	.51	.58	.66
29.5	2125	1679	1360	1124	944	805	694	604	531	471	420
	.13	.17	.21	.25	.29	.33	.38	.44	.50	.56	.63
33.0	2462	1946	1576	1302	1094	933	804	700	616	545	486
	.12	.16	.20	.24	.28	.32	.37	.42	.48	.54	.61
36.5	2800	2212	1792	1481	1244	1060	914	796	700	620	553
	.12	.15	.18	.22	.26	.31	.36	.41	.46	.52	.59
28.8	1913	1511	1224	1012	850	724	624	544	478	424	378
	.12	.16	.20	.24	.28	.33	.38	.44	.50	.56	.63
32.3	2263	1788	1448	1197	1006	851	734	644	566	501	447
	.12	.15	.19	.23	.28	.33	.38	.44	.50	.56	.63
35.8	2613	2064	1672	1382	1161	989	853	743	653	579	516
	.12	.15	.19	.23	.27	.32	.37	.43	.49	.55	.61
39.3	2963	2341	1896	1567	1317	1122	967	843	741	656	585
	.12	.15	.18	.22	.26	.31	.36	.41	.46	.52	.59

PENCOYD STEEL CORRUGATED FLOORING

Loads in pounds per sq. ft. of floor for a fibre stress of 15,000 lbs. per sq. inch. The figures in small type under the load in pounds are the corresponding centre deflections in inches. Those to the right of the dark line are where the centre deflection exceeds $\frac{1}{360}$ part of the span.

Section No. 210.

Weight of Material per Sq. Foot.	SPAN IN FEET.										
	6	7	8	9	10	11	12	13	14	15	16
14.8	1222	898	688	543	440	364	306	260	224	196	172
	.15	.21	.28	.35	.43	.52	.62	.73	.84	.97	1.10
18.4	1528	1122	859	679	550	455	382	325	281	244	215
	.15	.21	.28	.35	.43	.52	.62	.73	.84	.97	1.10
21.9	1833	1347	1031	815	660	545	458	391	337	293	258
	.15	.21	.28	.35	.43	.52	.62	.73	.84	.97	1.10
25.5	2150	1579	1209	956	774	640	533	458	395	344	302
	.15	.21	.28	.35	.43	.52	.62	.73	.84	.97	1.10
29.1	2467	1812	1388	1096	888	734	617	525	453	395	347
	.15	.21	.28	.35	.43	.52	.62	.73	.84	.97	1.10

Section No. 209.

8	9	10	11	12	13	14	15	16	17	18

Section No. 260.

	8	9	10	11	12	13	14	15	16	17	18
20.0	1641	1309	1050	868	729	621	536	467	410	363	324
	.17	.22	.27	.32	.38	.45	.52	.60	.68	.77	.86
23.6	2063	1630	1320	1091	917	781	693	587	516	457	407
	.16	.21	.26	.31	.37	.44	.51	.58	.65	.74	.83
27.1	2484	1963	1590	1314	1104	941	811	707	620	550	491
	.16	.20	.25	.30	.35	.41	.48	.55	.62	.71	.80
30.7	2906	2296	1860	1537	1292	1101	949	827	727	644	574
	.15	.19	.24	.29	.34	.40	.47	.54	.61	.69	.77
26.5	2234	1765	1430	1182	993	846	730	636	559	495	441
	.16	.20	.25	.30	.36	.43	.50	.57	.65	.73	.82
30.1	2656	2099	1700	1405	1181	1006	867	756	664	588	525
	.16	.20	.24	.29	.35	.41	.48	.55	.63	.71	.79
33.7	3078	2432	1970	1628	1368	1166	1005	876	770	682	608
	.15	.19	.24	.29	.34	.40	.46	.53	.60	.68	.76
37.2	3500	2765	2240	1851	1556	1325	1143	996	875	775	691
	.15	.10	.23	.28	.33	.39	.45	.51	.58	.66	.74
29.4	2391	1889	1530	1264	1063	905	781	680	598	529	472
	.16	.20	.24	.29	.35	.41	.48	.55	.63	.71	.79
32.9	2828	2235	1810	1496	1264	1071	923	804	707	626	559
	.16	.20	.24	.29	.35	.41	.48	.55	.62	.70	.39
36.5	3266	2580	2090	1727	1451	1237	1066	929	816	723	645
	.15	.19	.24	.29	.34	.40	.46	.53	.61	.69	.77
40.1	3703	2926	2370	1959	1646	1402	1209	1053	926	820	731
	.14	.18	.23	.28	.33	.38	.44	.51	.58	.65	.73

PENCOYD CORRUGATED FLOORING.

IRON OR STEEL.

Loads in pounds per square foot which cause a deflection equal to $\frac{1}{240}$ of the span.

Section No. 210.

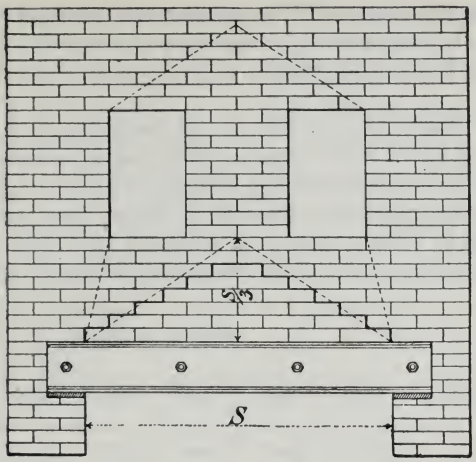
Weight of Material per Square Foot.		*SPAN IN FEET.*										
Iron.	*Steel.*	5	6	7	8	9	10	11	12	13	14	15
14.5	14.8	2460	1400	900	600	420	300	230	180	140	110	90
18.0	18.4	3000	1750	1100	740	520	380	290	220	170	140	110
21.5	21.9	3600	2120	1300	900	630	460	340	250	210	170	130
25.0	25.5	4200	2500	1570	1050	740	540	400	310	240	200	160
28.5	29.1	4800	2850	1800	1200	850	620	460	360	280	220	180

Section No. 209.

		SPAN IN FEET.										
		8	9	10	11	12	13	14	15	16	17	18
24.8		2320	1630	1210	900	700	550	440	360	290	240	210
27.8		2620	1840	1370	1020	790	620	500	400	330	280	230
30.7		2920	2050	1530	1140	880	690	550	450	370	310	260
33.6		3220	2260	1690	1260	970	760	610	500	410	340	290
36.6		3540	2480	1850	1380	1060	840	670	550	450	370	320

Section No. 260.

		SPAN IN FEET.										
		8	9	10	11	12	13	14	15	16	17	18
19.6	20.0	2420	1650	1200	880	680	540	430	350	290	240	200
23.1	23.6	3050	2200	1580	1200	910	710	570	460	380	310	260
26.6	27.1	3670	2650	1910	1450	1140	890	720	580	470	390	330
30.1	30.7	4650	3310	2350	1760	1380	1040	860	690	570	480	400
26.0	26.5	3300	2240	1630	1250	990	780	630	500	420	350	290
29.5	30.1	3920	2670	1940	1480	1170	950	770	620	510	430	360
33.0	33.7	4920	3280	2380	1790	1410	1140	910	750	620	510	430
36.5	37.2	5600	3980	2830	2220	1720	1330	1070	870	730	610	510
28.8	29.4	3830	2550	1840	1390	1090	860	690	550	460	390	320
32.3	32.9	4530	3220	2290	1720	1290	1010	810	660	540	460	380
35.8	36.5	5230	3720	2640	1990	1550	1210	970	780	640	540	450
39.3	40.1	5930	4210	3160	2350	1820	1410	1130	930	770	640	530



BEAMS SUPPORTING BRICK WALLS.

When the masonry alone, without any floor attachment, is supported, the load on the girder will vary according to several conditions. If the masonry is not thoroughly bonded throughout, or if great inflexibility is desired, it may be necessary to consider the whole mass of wall as sustained by the girder.

If the wall has no openings, and the brick is laid with the usual bond, the material incumbent on the girder would be indicated by the dark line—height, one-fourth of the span. It is best to consider this as a triangle, whose height equals one-third of span, as in lower dotted line; and as the weight of brick walls is nearly 10 lbs. per square foot for each inch of thickness, from these data we find the bending stress on the beam to be the same as that caused by a distributed load, in pounds equal to

$$\frac{25 \times \text{square of span in feet} \times \text{thickness of wall in inches.}}{9}$$

And from the table of distributed loads suitable beams can be selected, with proper limitations, for deflection, if the spans are long, to avoid cracking of wall. If the wall has

openings as illustrated, it is necessary to consider the mass of brickwork indicated by the upper course of dotted lines as supported by the beams, which can be selected accordingly.

It is usually best to use two or more beams bolted together, to give a better bearing or to insure lateral rigidity, and the following tables give suitable beams for solid brick walls properly bonded, selected to deflect less than $\frac{1}{360}$ of spans up to 10 feet, and $\frac{1}{300}$ of spans 15 to 20 feet. Particulars for separators for these beams can be found on page 244.

	SPANS IN FEET.					
Thickness of Wall in Inches.	8 *or* 9 *Feet.*	10 *or* 11 *Feet.*	12 *or* 13 *Feet.*	14 *or* 15 *Feet.*	16 *or* 17 *Feet.*	18 *or* 20 *Feet.*
9	1–4″ No. 19	1–5″ No. 17	2–6″ No. 16	2–7″ No. 14	2–7″ No. 14	2–9″ No. 10
13	1–5″ No. 17	2–5″ No. 17	2–6″ No. 15	2–8″ No. 14	2–8″ No. 12	2–10″ No. 8
18	2–5″ No. 17	2–6″ No. 16	2–7″ No. 14	2–8″ No. 12	2–8″ No. 12	2–10½″ No. 6
22	2–5″ No. 17	2–6″ No. 16	2–8″ No. 12	2–8″ No. 12	2–9″ No. 10	2–10½″ No. 5½

APPROXIMATE FORMULÆ FOR ROLLED BEAMS OF IRON OR STEEL.

The following rules for the strength and stiffness of rolled beams of various sections are intended for convenient application in cases where strict accuracy is not required.

The rules for rectangular and circular sections are correct, while those for the flanged sections are approximate and limited in their application to the standard shapes as given in our tables. They will be found to give results which have been proved by experiment to be sufficiently accurate for practical purposes. When the section of any beam is increased above the standard minimum dimensions, the flanges remaining unaltered, and the web alone being thickened, the tendency will be for the load as found by the rules to be in excess of the actual, but within the limits that it is possible to vary any section in the rolling, the rules will apply without any serious inaccuracy.

The loads are the same as in the beam tables, producing fibre stresses of 14,000 lbs. on iron and 16,800 lbs. per square inch on steel, on the assumption that the steel referred to has a tenacity 20 per cent. in excess of iron. These loads will be approximately one-half of loads that would injure the elasticity of the material.

The rules for deflection apply to any load below the elastic limit, or less than double the greatest safe load by the rules.

If the beams are long without lateral support, reduce the loads for the ratios of width to span, as described on page 40.

Example.—A 12-inch No. 4 iron **I** beam, area 12.03 square inches, 10 feet span, by the tables, will support a distributed load of 21.28 tons, and by the approximate rule $\frac{2970 \times 12.03 \times 12}{10} = 42{,}870$ lbs.

The deflection by the rule will also be found nearly as in the tables.

APPROX. GREATEST SAFE LOADS IN LBS. ON IRON OR STEEL BEAMS.

Based on fibre strains of 14,000 lbs. for iron and 16,800 lbs. for steel.

L = Length in feet between supports.
A = Sectional area of beam in square inches.
D = Depth of beam in inches.
a = Interior area in square inches.
d = Interior depth in inches.
w = Working load in net tons.

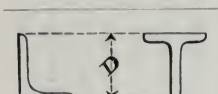
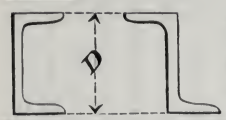
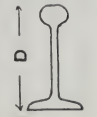
I.	II.	III.	IV.	V.	VI.	VII.
	W = *Greatest Safe Load in Pounds.*				$\triangle$ = *Deflection in Inches.*	
Shape of Section.	*Load in Middle of Beam.*		*Load Distributed.*			
	Iron.	*Steel.*	*Iron.*	*Steel.*	*Load in Middle.*	*Distributed Load.*
Solid Rectangle.	$W=\frac{780AD}{L}$	$W=\frac{940AD}{L}$	$W=\frac{1560AD}{L}$	$W=\frac{1880AD}{L}$	$\triangle=\frac{wL^3}{32AD^2}$	$\triangle=\frac{wL^3}{52AD^2}$
Hollow Rectangle.	$W=\frac{780(AD-ad)}{L}$	$W=\frac{940(AD-ad)}{L}$	$W=\frac{1560(AD-ad)}{L}$	$W=\frac{1880(AD-ad)}{L}$	$\triangle=\frac{wL^3}{32(AD^2-ad^2)}$	$\triangle=\frac{wL^3}{52(AD^2-ad^2)}$
Solid Cylinder.	$W=\frac{580AD}{L}$	$W=\frac{700AD}{L}$	$W=\frac{1160AD}{L}$	$W=\frac{1400AD}{L}$	$\triangle=\frac{wL^3}{24AD^2}$	$\triangle=\frac{wL^3}{38AD^2}$
Hollow Cylinder.	$W=\frac{580(AD-ad)}{L}$	$W=\frac{700(AD-ad)}{L}$	$W=\frac{1160(AD-ad)}{L}$	$W=\frac{1400(AD-ad)}{L}$	$\triangle=\frac{wL^3}{24(AD^2-ad^2)}$	$\triangle=\frac{wL^3}{38(AD^2-ad^2)}$

APPROX. GREATEST SAFE LOADS IN LBS. ON IRON OR STEEL BEAMS.

Based on fibre strains of 14,000 lbs. for iron and 16,800 lbs. for steel.

L = Length in feet between supports.
A = Sectional area of beam in square inches.
D = Depth of beam in inches.

a = Interior area in square inches.
d = Interior depth in inches.
w = Working load in net tons.

I.	II.	III.	IV.	V.	VI.	VII.
	W = *Greatest Safe Load in Pounds.*				$\triangle$ = *Deflection in Inches.*	
Shape of Section.	*Load in Middle of Beam.*		*Load Distributed.*		*Load in Middle.*	*Distributed Load.*
	Iron.	*Steel.*	*Iron.*	*Steel.*		
 *Even-legged Angle or Tee.*	$W=\frac{770AD}{L}$	$W=\frac{930AD}{L}$	$W=\frac{1540AD}{L}$	$W=\frac{1860AD}{L}$	$\triangle=\frac{wL^3}{32AD^2}$	$\triangle=\frac{wL^3}{52AD^2}$
 *Channel or Z Bars.*	$W=\frac{1335AD}{L}$	$W=\frac{1600AD}{L}$	$W=\frac{2370AD}{L}$	$W=\frac{3200AD}{L}$	$\triangle=\frac{wL^3}{53AD^2}$	$\triangle=\frac{wL^3}{85AD^2}$
 *Deck Beam.*	$W=\frac{1200AD}{L}$	$W=\frac{1450AD}{L}$	$W=\frac{2400AD}{L}$	$W=\frac{2900AD}{L}$	$\triangle=\frac{wL^3}{50AD^2}$	$\triangle=\frac{wL^3}{80AD^2}$
I *Beam.*	$W=\frac{1485AD}{L}$	$W=\frac{1785AD}{L}$	$W=\frac{2970AD}{L}$	$W=\frac{3560AD}{L}$	$\triangle=\frac{wL^3}{58AD^2}$	$\triangle=\frac{wL^3}{93AD^2}$

The preceding rules apply to beams supported at each end. For beams supported otherwise alter the coefficients of the table as described below, referring to the respective columns indicated by number.

CHANGES OF COEFFICIENTS FOR SPECIAL FORMS OF BEAMS.

Kind of Beam.	*Coefficient for Safe Load.*	*Coefficient for Deflection.*
Fixed at one end, loaded at the other.	One-fourth ($\frac{1}{4}$) of the coefficient of col. II or III.	One-sixteenth ($\frac{1}{16}$) of the coefficient of col. VI.
Fixed at one end, load evenly distributed.	One-fourth ($\frac{1}{4}$) of the coefficient of col. IV or V.	Five-forty-eighths ($\frac{5}{48}$) of the coefficient of col. VII.
Both ends rigidly fixed, or a continuous beam, with a load in middle.	Twice the coefficient of col. II or III.	Four times the coefficient of col. VI.
Both ends rigidly fixed, or a continuous beam with load evenly distributed.	One and one-half ($1\frac{1}{2}$) times the coefficient of col. IV or V.	Five times the coefficient of col. VII.

It will be observed that these rules apply only to the intermediate spans of continuous beams; when continuity does not occur at the ends, the conditions are altered. If, however, the outer ends of a continuous beam overhang the end-supports from one-fifth to one-fourth of a span, and bear the same proportion of load as the parts between supports, then the outer spans may be of same length as the intermediate spans, subject to the same load, and the strength and stiffness are determined by the same rules; otherwise the outer spans ought to be only four-fifths of the

length of the intermediate spans when the load is distributed, or three-fourths of the same when the load is concentrated in the middle; or, if the lengths of spans are all alike, the loads on outer spans ought to be reduced in the same proportion.

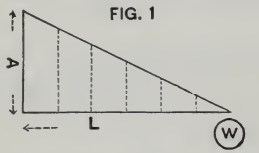
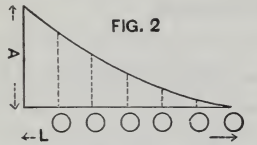
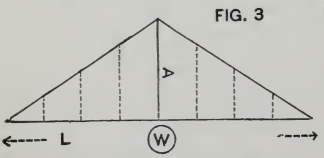
The following table exhibits the relative proportion of strength and stiffness existing between various classes of beams when they have the same lengths and uniform cross-section; the deflections being comparative figures for the same loads on any beam.

Kind of Beam.	*Maximum Load as*	*Deflection as*
Fixed at one end—loaded at the other	$\frac{1}{4}$	16
Fixed at one end—load evenly distributed	$\frac{1}{2}$	6
Supported at both ends—load in middle	1	1
Supported at both ends—load evenly distributed	2	$\frac{5}{8}$
Continuous beam—load in middle	2	$\frac{1}{4}$
Continuous beam—load evenly distributed	3	$\frac{1}{8}$

The load and deflection of a beam supported at both ends and loaded in the middle have been taken as the units for comparison. Beams of uniform length and section will be equally strained when loaded in the ratio described in the first column, or if the beams are loaded equally, within their elastic limits, the respective deflections will be in the ratio described in second column.

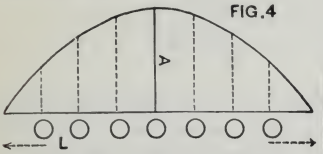
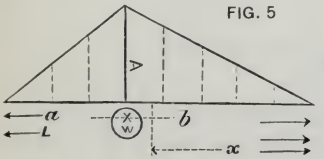
BENDING MOMENTS AND DEFLECTIONS FOR BEAMS OF UNIFORM SECTION.

W = Total load. E = Modulus of elasticity.
L = Length of beam. I = Moment of inertia.

Form of Beam and Position of Load.	*Maximum Bending Moment.*	*Maximum Shearing Stress.*	*Deflection.*
Beam fixed at one end, loaded at the other:  Draw triangle having $A = WL$. Vertical lines give bending moments at corresponding points on the beam.	at point of support $= WL$.	at point of support $= W$.	at end of beam $= \frac{WL^3}{3EI}$.
Beam fixed at one end, load uniformly distributed:  Draw parabola having $A = \frac{WL}{2}$. Ordinates give bending moments at corresponding points on the beam.	at point of support $= \frac{WL}{2}$.	at point of support $= W$.	at end of beam $= \frac{WL^3}{8EI}$.
Beam supported at both ends, loaded in the middle:  Draw triangle having $A = \frac{WL}{4}$. Vertical lines give bending moments at corresponding points on the beam.	at middle of beam $= \frac{WL}{4}$.	at point of support $= \frac{W}{2}$.	at middle of beam $= \frac{WL^3}{48EI}$.

BENDING MOMENTS AND DEFLECTIONS FOR BEAMS OF UNIFORM SECTION.

W = Total load. E = Modulus of elasticity.
L = Length of beam. I = Moment of inertia.

Form of Beam and Position of Load.	*Maximum Bending Moment.*	*Maximum Shearing Stress.*	*Deflection.*
Beam supported at both ends, load uniformly distributed:  Draw parabola having $A = \frac{WL}{8}$. Ordinates give bending moments at corresponding points on the beam.	at middle of beam $= \frac{WL}{8}$.	at point of support $= \frac{W}{2}$.	at middle of beam $= \frac{WL^3}{76.8EI}$.
Beam supported at both ends, load concentrated at any point:  Draw triangle having $A = \frac{Wab}{L}$. Vertical lines give bending moments at corresponding points on the beam.	at position of load $= \frac{Wab}{L}$.	at point of support next to a $= \frac{Wb}{L}$. at point of support next to b $= \frac{Wa}{L}$.	at position of load $= \frac{a^2b^2W}{3EIL}$. Max. def. at x $= \frac{Wab(a+L)}{EIL}\sqrt{\frac{3b(a+L)}{a}}$, a being less than b. $x = \sqrt{\frac{b(a+L)}{3}}$

BENDING MOMENTS AND DEFLECTIONS FOR BEAMS OF UNIFORM SECTION.

W = Total load. E = Modulus of elasticity.
L = Length of beam. I = Moment of inertia.

Beam supported at both ends, with concentrated loads at various points:

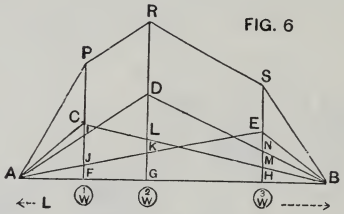


FIG. 6

Draw (by 5) the triangles having vertices at C, D and E, the verticals representing bending moments for loads w^1, w^2 and w^3, respectively. Extend FC to P, GD to R, and HE to S, making each long vertical equal to the sum of the bending moments corresponding to its position. That is, $FP = FC + FI + FJ$. $GR = GD + GL + GK$. And $HS = HE + HN + HM$. Verticals drawn from any point on the polygon, $APRSB$ to AB, will represent the bending moments at the corresponding points on the beam.

Beam rigidly secured at each end, and loaded in the middle. Or the intermediate spans of a continuous beam, equally loaded in the middle of each span:

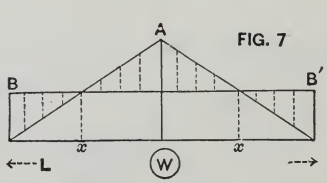


FIG. 7

Points of contraflexure at x, x, where Moment $= 0$. Distance of x from either support $= \frac{L}{4}$. Equal moments at middle and ends $= \frac{WL}{8}$. Deflection $= \frac{WL^3}{192EI}$.

Draw a triangle having $A = \frac{WL}{4}$, and at ends draw verticals BB', each $= \frac{WL}{8}$, join BB'. The vertical distances between BB' and the sides of the triangle represent the moments for corresponding points on the beam.

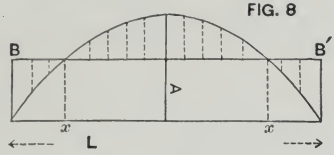
BENDING MOMENTS AND DEFLECTIONS FOR BEAMS OF UNIFORM SECTIONS.

W = Total load. E = Modulus of elasticity.
L = Length of beam. I = Moment of inertia.

Beam rigidly secured at each end, with load uniformly distributed.

Or the intermediate spans of a continuous beam bearing a uniformly distributed load on each span.

FIG. 8



Points of contraflexure at x, x, where moment $= 0$. Distance of x from either support $= .21L$.

Draw parabola having $A = \frac{WL}{8}$. Draw verticals B, B', each equal to $\frac{WL}{12}$, join BB'. The vertical distances between BB' and the curve of the parabola represent the moments of corresponding points on the beam.

Maximum moment at points of support $= \frac{WL}{12}$.

Moment at middle of beam $= \frac{WL}{24}$.

Maximum deflection at middle of beam $= \frac{WL^3}{384EI}$.

BEAMS FOR SUPPORTING IRREGULAR LOADS.

When a beam has its load unequally distributed, the proper size of the beam can be determined by finding the maximum bending moment and proportioning the beam accordingly. Equilibrium is obtained when the bending moment is equal to the moment of resistance. That is, when the external force multiplied by the leverage with which it acts is equal to the strength of the material in the cross-section of the beam multiplied by the leverage with which it acts.

The resistance of a beam is found by dividing the moment of inertia of the section by the distance from neutral axis to extreme fibres, and this value for any rolled section will be found in the tables, pages 150 to 170. This tabulated resistance, multiplied by the limiting fibre stress on the beam, is the measure of strength of the section.

RULE FOR BEAMS BEARING IRREGULAR LOADS.

Finding by the methods described on pages 126 to 129, the maximum bending moment on the beam, divide the bending moment by the limiting fibre stress, and select from the tables, pages 150 to 170, a beam whose resistance is not less than this quotient. The greatest safe fibre stress in our tables is 14,000 lbs. for iron and 16,800 lbs. for steel. These stresses to be modified for various considerations, as described on pages 39 to 41.

Example.—An **I** beam 8 feet long is to be fixed at one end and loaded at the other with 5,000 lbs. and carrying also an evenly distributed load of 8,000 lbs. What size of beam should be used so as not to be strained over 14,000 lbs. for iron or 16,800 lbs. for steel?

Moment for end load $= 5{,}000 \times 96 = 480{,}000$ inch-lbs.

" " distributed load $= \frac{8{,}000 \times 96}{2} = 384{,}000$ " "

Total $= 864{,}000$ " "

Divide this bending moment by the fibre stresses afore-

said, and select from column XII., page 121, beams whose resistances are nearest the quotients, as follows:

12-inch. No. 3. 57.1 lbs. per foot } for iron.
or 15-inch. No. 521. 41.6 " " " }

12-inch. No. 4. 51.0 " " " } for steel.
or 15-inch. No. 521. 42 " " " }

The 15-inch beams being both strongest and lightest.

In some instances the maximum bending moment can be most readily found by the use of diagrams, as described in the succeeding article. When this is done use any convenient scale, making all loads and all distances respectively of the same denominations. The maximum bending moment can then be measured to scale.

Example.—A beam 20 feet long between supports will carry three loads, which we will call A, B and C.

$A = 4{,}000$ lbs. and is 4 feet from one end of the beam.

$C = 6{,}000$ lbs. and is 3 feet from the other end of the beam.

$B = 5{,}000$ lbs. and is 5 feet from C and 8 feet from A.

Required a suitable beam, not strained over 10,000 lbs. for iron or 12,000 lbs. for steel.

Describe a diagram as in Fig. 6, page 128, when the following bending moments will be obtained.

At point A.		At point B.		At point C.	
For load A,	12,800	For load B,	24,000	For load C,	15,300
" B,	8,000	" A,	10,800	" B,	8,900
" C,	3,600	" C,	6,400	" A,	2,400
Total,	24,400	Total,	41,200	Total,	26,600

The maximum moment at $B = 41{,}200$ foot-lbs. or 494,400 inch-lbs. Dividing by 10,000 and 12,000, select the following beams, whose resistances are nearest the quotients, column XII., page 121.

15-inch iron beam, No. 521, 41 lbs. per foot, or
12-inch steel " No. 515, 30 " " "

NOTE.—The tables of elements, except where otherwise specified, are calculated for dimensions in inches and weights in pounds, consequently in examples of above character it is necessary to obtain bending moments in inch-pounds.

BEAMS SUBJECT TO BOTH BENDING AND COMPRESSION.

When a beam is subjected to bending action and simultaneously has to act as a strut by resisting compression, the stress of the fibres of the beam otherwise in tension will be relieved and those in compression correspondingly augmented.

No general rules can be given for such conditions, as every particular case requires its own proper determination. The following methods, though not strictly correct, will give safe results for some simple forms of trussed girders, etc.

WHEN THE BEAM IS SUBJECT TO COMPRESSION, BUT IS SO CONFINED LATERALLY THAT IT CANNOT FAIL BY BENDING LIKE A STRUT.

Rule.—Find by the methods previously described the section of beam required to resist bending, then allowing from 10,000 to 17,000 lbs. per square inch for the compression, according to the material or factor of safety used, add the two sectional areas together, which will give the section of beam required.

Example.—A beam trussed 3 feet deep in the manner illustrated at Fig. 6, page 218, spans an opening of 30 feet, the beam having ample lateral support, and bearing a uniform load of 500 lbs. per lineal foot. Required a suitable beam strained about 12,000 lbs. per inch.

The trussed beam can be considered as composed of two beams reaching from the centre of truss to each support. Each beam 15 feet long, uniform load 7,500 lbs., and subject to a compression resulting from the trussing of 18,750 lbs.

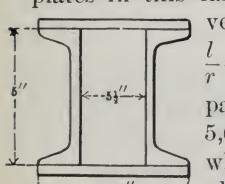
Bending moment $= \frac{7{,}500 \times 180}{8}$, dividing this by fibre stress of 12,000 lbs. gives a quotient 14. The nearest resistance for an **I** beam, column XII., page 153, is 8 inches, 5.08 square inches area, adding for compression $\frac{18{,}750}{12{,}000} = 1.56$ square inch, or a total area of 6.64 square inches for an 8-inch beam.

WHEN THE BEAM IS SUBJECT TO COMPRESSION AND IS LIABLE TO FAIL LIKE A HORIZONTAL STRUT BY LATERAL FLEXURE.

Rule.—Consider first the resistance as a strut and then make the necessary increment of section to resist the bending stress, remembering that if the addition is made to the flanges then only flange stresses have to be considered, but if the increased area is obtained by thickening the web of **I** beam or channel section, then the additional area so obtained should be treated as a rectangular section whose thickness is the amount added to the web, and whose depth is the depth of the beam.

Example.—A trussed girder of the form exhibited in Fig. 8, page 218, is a box section made up of two channels separated with flanges outward, and plated top and bottom. The whole girder is 30 feet long and is loaded 1,000 lbs. per lineal foot. The compression resulting from the trussing is 25,000 lbs. The structure has no lateral bracing. What will be safe proportions for it, the stresses not to exceed one-fifth of the ultimate, or 10,000 lbs. per inch?

It is evident that we have to consider it as a flat-ended strut 30 feet long, liable to fail horizontally, and also as a series of three beams each 10 feet long and loaded with 10,000 lbs. evenly distributed. Trying two light 5-inch channels, each 2.5 square inches section, separated $5\frac{1}{2}$ inches so as to be covered by 9-inch plates, we have (omitting the plates in this calculation) the radius of gyration around vertical axis (see page 174) = 3.4 inches, $\frac{l}{r} = 106$, one-fifth of ultimate (by Table I, page 182) = 5,600 lbs. per square inch, or 5,600 × 5 = 28,000 lbs. safe resistance, which is ample. Now proportioning the plates to resist the bending strain, we have maximum bending moments (see page 127), $\frac{120 \times 10{,}000}{8}$ = 150,000 inch-lbs.



The plates act with a leverage equal to the depth of the

channel, viz., 5 inches; $\frac{150{,}000}{5} = 30{,}000$ lbs. tension on top or compression on bottom plate, which, allowing for 10,000 lbs. per square inch, and allowing for loss by rivets, will require a plate $\frac{3}{8}$ inch thick.

Taking the last example, if it was desired to form the section from a pair of channels latticed top and bottom with no cover plates, we would have to consider the section added to the channels (being on the web alone) as a simple rectangular section. By the formula on page 122, approximate rules, we find that such a section only 5 inches deep would require a thickness of 3.8 inches, which is impracticable; we have therefore to use deeper and heavier channels. Trying 8-inch channels separated as before $5\frac{1}{2}$ inches, with flanges outward, and having radius of gyration for the pair around vertical axis $= 3.4$, $\frac{l}{r} = 106$. Safe load $\frac{29{,}000}{5}$ $= 5{,}800$ lbs. per square inch. As the compression is 25,000 lbs., there is required 4.3 square inches for this purpose. By formula IV, page 122, $\frac{1100 \times \text{area} \times 8}{10} = 10{,}000$ lbs., from which is found the area required to resist bending $= 12$ square inches. $12 + 4.3 = 16.3$ square inches for two channels, or the heaviest 8-inch channels 27 lbs. per foot would be required.

By the same method we find 10-inch channels, 23 lbs. per foot, will answer the purpose, or our lightest 12-inch channels, 20 lbs. per foot, will exactly meet the requirements and be the lightest channel that can be used in the manner proposed for the purpose.

In cases where the load is concentrated at the truss points, there being no bending stress, the resistance as a strut has only to be considered, and when braced laterally the strut length is reduced to the distances between bracing.

BEAMS OF ANGLE AND TEE SECTION.

It is frequently convenient to use angle or tee sections for roof purlines and similar purposes.

The length of span may be so great as compared to depth in these cases, that deflection instead of excessive fibre stress is the measure of utility.

An even-flanged angle or tee will deflect slightly less than an equally loaded rectangular section of the same depth and sectional area; but the extreme fibre stress of the former will be greater than in the rectangular section.

Therefore, for long beams, where deflection reaches the permissible limit before fibre stress becomes excessive, the rule for beams of angle and tee section given on page 123 will safely apply.

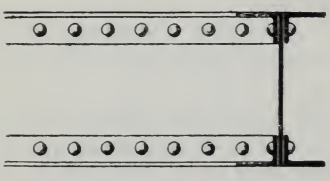
If, however, the fibre stress must be kept lower than this rule indicates, refer to the columns "resistance," pages 166 to 171, and apply as described on page 130.

Example.—A 4″ × 4″ iron tee, 3.72 square inches area, has a resistance of 1.97 (see col. VIII, page 170). Required its greatest safe load distributed over a beam of 10 feet span.

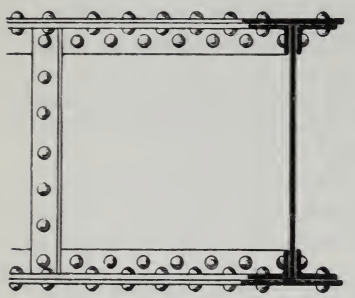
By the method on page 127, bending moment $= \frac{120w}{8} =$ 1.97 × 14,000 lbs., or $w =$ 1,750 lbs. nearly.

By the rule on page 123, col. IV, the safe load would be $\frac{1540 \times 3.72 \times 4}{10} =$ 2,290 lbs., and the deflection by col. VII, page 123, would be $\frac{1.145 \times 1090}{52 \times 3.72 \times 16} =$ .37 inch, or only a little over $\frac{1}{360}$ of the span, while the extreme fibre stress at the outer edge of the stem would be about 17,000 lbs., or sufficiently below the elastic limit to justify its use for light purlines, etc.

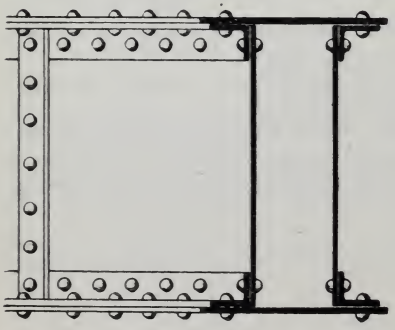
RIVETED GIRDERS.



For Table, see Page 139.



For Tables, see Pages 140–141.



For Tables, see Pages 142 to 147.

RIVETED GIRDERS.

The tables, pages 139 to 147, represent a few of the sections of riveted girders most frequently used in structures. The single-webbed girders are the most economical in material, and most accessible for painting and inspection. But where great width and lateral stiffness are required, the double web or box girder is the best. If the length of the girder exceeds twenty times the width of the flange, the girder should either be given some lateral support, or else the section of the top flange should be increased. It is usual to allow flange strains of 12,000 lbs. per square inch for iron, or about 20 per cent. more for steel, in girders for buildings. The safe loads for the girders in the accompanying tables are calculated on this assumption for iron, the entire sectional area of the girder being considered.

For steel having tensile strength of not less than 60,000 lbs. the tabulated coefficients may be increased 20 per cent.

The web of the girder should be made of such thickness that the vertical shearing strain will not exceed three-fourths of the horizontal strains, or 9,000 lbs. per square inch of section in the case of iron girders for buildings. The shearing strain is greatest at the supports, and is found by dividing half the load on the girder by the web section.

If the thickness of the web is less than $\frac{1}{60}$ of its depth, it should be stiffened to resist buckling, by the addition of vertical angle irons riveted to the web at intervals of not more than the depth of the girder. These stiffeners should always be used at the supports and at points where concentrated loading occurs.

The rivets should be from $\frac{3}{4}$ to $\frac{7}{8}$ inch in diameter, spaced not closer than three diameters, nor farther apart than sixteen times the thickness of plate connected.

It is good practice to limit the least depth of the girder to $\frac{1}{20}$ of the span, on account of deflection.

The following tables are calculated by the moments of inertia of the girder sections, for a fibre strain of 12,000 lbs. per square inch, and for a uniformly distributed load.

$$\text{Coefficient} = \frac{\text{Inertia} \times 8}{\text{extreme depth of girder}}.$$ The numbers in the

first columns of the tables correspond with those of the various sections of girders on the plates.

The tables give coefficients of strength, also weights per lineal foot, including stiffeners for each section, excepting girders without cover plates in first table, where stiffeners are omitted.

TO FIND THE SAFE DISTRIBUTED LOAD FOR ANY GIRDER.

Divide the coefficient of strength by the length of span in feet between centres of supports. The quotient will be the load in tons of 2,000 lbs.

TO FIND THE COEFFICIENT OF STRENGTH NECESSARY TO CARRY A CERTAIN LOAD ON A GIVEN SPAN.

Multiply the load in tons of 2,000 lbs. by the length of span in feet between centres of supports. If the load is concentrated at the centre of the girder, it must not exceed one-half the weight of the permissible uniformly distributed load. If the load is concentrated at some point not in the middle of the girder, it may exceed in weight the permissible middle load, in the ratio of the square of half the span, to the product of the segments formed by the position of the load.

EXAMPLES FOR APPLICATION OF TABLES.

I. What is the carrying capacity of the single-web plate girder No. 16, with $\frac{3}{4}$-inch cover or flange plates, the girder being 20 feet long between centres of supports?

In the column of coefficients, and opposite the girder referred to, find proper coefficient for strength, which in this case is 2,143.

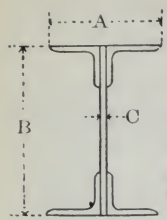
Answer. $\frac{2143}{20} = 107.15$ tons equally distributed,

or 53.57 tons in middle of girder.

II. A box girder is required 24 feet long between supports to carry a 20-inch brick wall weighing 66 tons. What is the requisite coefficient of strength?

Answer. $66 \times 24 = 1584$.

Referring to the table of box girders 20 inches wide, we find that girder No. 15, 21 inches deep, with a $\frac{5}{8}$-inch cover plate, has a coefficient of strength of 1610, or a little in excess of that required.



STRENGTH AND WEIGHT OF WROUGHT IRON RIVETED GIRDERS.

To find the distributed safe load in net tons, divide the coefficient in right-hand column by the length of span in feet.

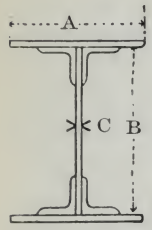
To find the coefficients of strength for a given load and span, multiply the uniformly distributed load in tons by the span in feet between centres of supports.

Weights do not include stiffeners.

Depth. B.	*Web Thickness. C.*	*Flange Width. A.*	*Size of Angles.*	*Resistance.*	*Weight in Pounds per Lineal Foot.*	*Coefficient of Strength.*
18	$\frac{5}{16}$	$10\frac{5}{16}$	5 x $3\frac{1}{2}$ x $\frac{5}{16}$	92.9	55.9	371.5
18	$\frac{3}{8}$	$10\frac{3}{8}$	5 x $3\frac{1}{2}$ x $\frac{3}{8}$	110.0	66.0	440.0
18	$\frac{7}{16}$	$10\frac{7}{16}$	5 x $3\frac{1}{2}$ x $\frac{7}{16}$	126.9	76.2	507.6
18	$\frac{1}{2}$	$10\frac{1}{2}$	5 x $3\frac{1}{2}$ x $\frac{1}{2}$	143.7	86.3	574.6
20	$\frac{3}{8}$	$10\frac{3}{8}$	5 x $3\frac{1}{2}$ x $\frac{3}{8}$	126.8	68.5	507.6
20	$\frac{7}{16}$	$10\frac{7}{16}$	5 x $3\frac{1}{2}$ x $\frac{7}{16}$	146.4	79.1	585.3
20	$\frac{1}{2}$	$10\frac{1}{2}$	5 x $3\frac{1}{2}$ x $\frac{1}{2}$	165.8	89.7	663.2
22	$\frac{3}{8}$	$10\frac{3}{8}$	5 x $3\frac{1}{2}$ x $\frac{3}{8}$	144.1	71.0	576.6
22	$\frac{7}{16}$	$10\frac{7}{16}$	5 x $3\frac{1}{2}$ x $\frac{7}{16}$	166.5	82.0	666.0
22	$\frac{1}{2}$	$10\frac{1}{2}$	5 x $3\frac{1}{2}$ x $\frac{1}{2}$	188.7	93.0	754.8
24	$\frac{3}{8}$	$11\frac{3}{8}$	$5\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{3}{8}$	170.7	76.1	682.7
24	$\frac{7}{16}$	$11\frac{7}{16}$	$5\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{7}{16}$	198.1	88.1	792.3
24	$\frac{1}{2}$	$11\frac{1}{2}$	$5\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{1}{2}$	225.4	100.2	901.7
26	$\frac{3}{8}$	$11\frac{3}{8}$	$5\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{3}{8}$	189.7	78.6	758.8
26	$\frac{7}{16}$	$11\frac{7}{16}$	$5\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{7}{16}$	220.4	91.1	881.4
26	$\frac{1}{2}$	$11\frac{1}{2}$	$5\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{1}{2}$	250.9	103.5	1003.4
28	$\frac{3}{8}$	$12\frac{3}{8}$	6 x $3\frac{1}{2}$ x $\frac{3}{8}$	218.0	83.2	872.0
28	$\frac{7}{16}$	$12\frac{7}{16}$	6 x $3\frac{1}{2}$ x $\frac{7}{16}$	255.5	97.0	1022.0
28	$\frac{1}{2}$	$12\frac{1}{2}$	6 x $3\frac{1}{2}$ x $\frac{1}{2}$	292.8	110.9	1171.4
30	$\frac{3}{8}$	$13\frac{3}{8}$	$6\frac{1}{2}$ x 4 x $\frac{3}{8}$	256.3	90.9	1025.1
30	$\frac{7}{16}$	$13\frac{7}{16}$	$6\frac{1}{2}$ x 4 x $\frac{7}{16}$	298.5	105.6	1193.9
30	$\frac{1}{2}$	$13\frac{1}{2}$	$6\frac{1}{2}$ x 4 x $\frac{1}{2}$	340.4	120.2	1361.5
32	$\frac{3}{8}$	$13\frac{3}{8}$	$6\frac{1}{2}$ x 4 x $\frac{3}{8}$	279.2	93.4	1116.8
32	$\frac{7}{16}$	$13\frac{7}{16}$	$6\frac{1}{2}$ x 4 x $\frac{7}{16}$	325.1	108.5	1300.4
32	$\frac{1}{2}$	$13\frac{1}{2}$	$6\frac{1}{2}$ x 4 x $\frac{1}{2}$	370.6	123.5	1482.5
34	$\frac{3}{8}$	$13\frac{3}{8}$	$6\frac{1}{2}$ x 4 x $\frac{3}{8}$	302.5	95.9	1210.0
34	$\frac{7}{16}$	$13\frac{7}{16}$	$6\frac{1}{2}$ x 4 x $\frac{7}{16}$	352.3	111.4	1409.2
34	$\frac{1}{2}$	$13\frac{1}{2}$	$6\frac{1}{2}$ x 4 x $\frac{1}{2}$	401.8	126.9	1607.2
36	$\frac{3}{8}$	$13\frac{3}{8}$	$6\frac{1}{2}$ x 4 x $\frac{3}{8}$	326.3	98.4	1305.2
36	$\frac{7}{16}$	$13\frac{7}{16}$	$6\frac{1}{2}$ x 4 x $\frac{7}{16}$	380.1	114.3	1520.4
36	$\frac{1}{2}$	$13\frac{1}{2}$	$6\frac{1}{2}$ x 4 x $\frac{1}{2}$	433.5	130.2	1734.2

Number of Section.	Depth of Girder in Inches.	Width of Cover Plates in Inches.	THICKNESS OF COVER PLATES IN INCHES.																Width of Cover Plates in Inches.	Depth of Girder in Inches.	Number of Section.
			3/8		1/2		5/8		3/4		7/8		1		1 1/8		1 1/4				
			Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.			
1	18	12	752	103	845	113	957	123	1061	133	1164	143	1268	153	1372	163	1476	173	12	18	1
2	18	12			1046	136	1146	146	1247	156	1348	166	1450	176	1552	186	1654	196	12	18	2
3	18	12					1220	168	1319	178	1420	188	1520	198	1621	208	1721	218	12	18	3
4	21	12	906	108	1026	118	1146	128	1267	138	1388	148	1509	158	1630	168	1751	178	12	21	4
5	21	12			1186	143	1304	153	1224	163	1543	173	1663	183	1783	193	1903	203	12	21	5
6	21	12					1477	176	1594	186	1707	196	1829	206	1948	216	2068	226	12	21	6
7	24	12	1064	112	1202	122	1340	132	1479	142	1618	152	1757	162	1887	172	2026	182	12	24	7
8	24	12			1396	150	1532	160	1669	170	1805	180	1942	190	2079	200	2216	210	12	24	8
9	24	12					1743	185	1879	195	2012	205	2147	215	2283	225	2417	235	12	24	9
10	27	12	1228	118	1384	128	1540	138	1696	148	1851	158	2007	168	2163	178	2319	188	12	27	10
11	27	12			1612	155	1766	165	1920	175	2073	185	2229	195	2384	205	2540	215	12	27	11
12	27	12					2018	194	2170	204	2322	214	2474	224	2627	234	2578	244	12	27	12
13	30	12	1397	123	1570	133	1744	143	1917	153	2090	163	2263	173	2436	183	2609	193	12	30	13
14	30	12			1835	163	2006	173	2178	183	2350	193	2522	203	2694	213	2866	223	12	30	14
15	30	12					2301	201	2470	211	2631	221	2809	231	2980	241	3150	251	12	30	15
16	33	12	1570	127	1761	137	1952	147	2143	157	2335	167	2527	177	2719	187	2911	197	12	33	16
17	33	12			2064	169	2253	179	2442	189	2631	199	2821	209	3011	219	3201	229	12	33	17
18	33	12					2591	208	2778	218	2965	228	3152	238	3340	248	3527	258	12	33	18
19	36	12	1748	131	1956	141	2165	151	2396	161	2584	171	2793	181	3002	191	3211	201	12	36	19
20	36	12			2303	174	2507	184	2714	194	2921	204	3128	214	3335	224	3542	234	12	36	20
21	36	12					2890	214	3094	224	3299	234	3504	244	3708	254	3913	264	12	36	21

STRENGTH AND WEIGHT OF WROUGHT IRON RIVETED GIRDERS.



To find the distributed safe load in net tons, divide the coefficient on opposite page corresponding to the number below by the length of span in feet.

To find the coefficient of strength for a given load and span, multiply the uniformly distributed load in tons by the span in feet between centres of supports.

See opposite page for coefficients.

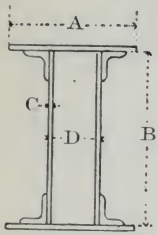
Weights include stiffeners.

Number of Section.	*Width of Cover (A) in Inches.*	*Depth of Web (B) in Inches.*	*Thickness of Web (C) in Inches.*	*Size of Corner Angles in Inches.*
1	12	18	3/8	5 x 3½ x 3/8
2	12	18	½	5 x 3½ x ½
3	12	18	5/8	5 x 3½ x 5/8
4	12	21	3/8	5 x 3½ x 3/8
5	12	21	½	5 x 3½ x ½
6	12	21	5/8	5 x 3½ x 5/8
7	12	24	3/8	5 x 3½ x 3/8
8	12	24	½	5 x 3½ x ½
9	12	24	5/8	5 x 3½ x 5/8
10	12	27	3/8	5 x 3½ x 3/8
11	12	27	½	5 x 3½ x ½
12	12	27	5/8	5 x 3½ x 5/8
13	12	30	3/8	5 x 3½ x 3/8
14	12	30	½	5 x 3½ x ½
15	12	30	5/8	5 x 3½ x 5/8
16	12	33	3/8	5 x 3½ x 3/8
17	12	33	½	5 x 3½ x ½
18	12	33	5/8	5 x 3½ x 5/8
19	12	36	3/8	5 x 3½ x 3/8
20	12	36	½	5 x 3½ x ½
21	12	36	5/8	5 x 3½ x 5/8

THICKNESS OF COVER PLATES IN INCHES.

Number of Section.	Depth of Girder in Inches.	Width of Cover Plates in Inches.	3/8		1/2		5/8		3/4		7/8		1		1 1/8		1 1/4		Width of Cover Plates in Inches.	Depth of Girder in Inches.	Number of Section.
			Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.			
1	18	16	863	131	1002	144	1141	157	1280	170	1420	183	1560	196	1701	209	1841	223	16	18	1
2	18	16			1132	173	1270	186	1408	199	1546	212	1684	225	1824	238	1962	251	16	18	2
3	21	16	1050	140	1212	153	1375	166	1538	179	1701	192	1864	205	2029	218	2192	231	16	21	3
4	21	16			1380	185	1540	198	1701	211	1862	224	2024	237	2186	250	2348	263	16	21	4
5	24	16	1247	149	1432	162	1618	175	1836	188	1995	201	2178	214	2366	227	2552	240	16	24	5
6	24	16			1640	197	1824	210	2008	223	2192	236	2377	249	2562	262	2747	275	16	24	6
7	27	16	1453	158	1662	171	1871	184	2081	197	2284	210	2501	223	2712	236	2922	249	16	27	7
8	27	16			1912	209	2119	222	2327	235	2534	248	2742	261	2951	274	3160	287	16	27	8
9	30	16	1668	167	1901	180	2133	193	2366	206	2600	219	2834	232	3068	245	3304	258	16	30	9
10	30	16			2197	221	2427	234	2658	247	2889	260	3120	273	3352	286	3583	299	16	30	10
11	33	16	1942	175	2148	188	2405	201	2650	214	2918	227	3175	240	3435	253	3694	266	16	33	11
12	33	16			2494	232	2748	245	3002	258	3256	271	3511	284	3766	297	4020	310	16	33	12
13	36	16	2128	183	2428	196	2708	209	2988	222	3268	235	3548	248	3807	261	4088	274	16	36	13
14	36	16			2803	242	3080	255	3358	268	3634	281	3916	294	4192	307	4468	320	16	36	14
15	21	20	1206	153	1406	170	1610	187	1815	203	2020	220	2225	236	2435	253	2640	270	20	21	15
16	21	20			1579	204	1788	221	1986	237	2194	254	2398	270	2602	287	2806	304	20	21	16
17	24	20	1425	162	1690	179	1892	196	2126	212	2360	229	2592	245	2830	262	3064	279	20	24	17
18	24	20			1876	216	2108	233	2340	249	2572	266	2804	282	3038	299	3272	316	20	24	18

STRENGTH AND WEIGHT OF WROUGHT IRON RIVETED GIRDERS.



To find the distributed safe load in net tons, divide the coefficient on opposite page corresponding to the number below by the length of span in feet.

To find the coefficient of strength for a given load and span, multiply the uniformly distributed load in tons by the span in feet between centres of supports.

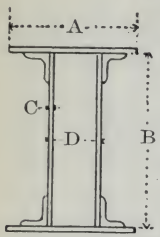
See opposite page for coefficients.

Number of Section.	*Width of Cover (A) in Inches.*	*Depth of Web (B) in Inches.*	*Thickness of Web (C) in Inches.*	*Width of (D) in Inches.*	*Size of Corner Angles in Inches.*
1	16	18	3/8	8	3½ x 3½ x 3/8
2	16	18	½	8	3½ x 3½ x ½
3	16	21	3/8	8	3½ x 3½ x 3/8
4	16	21	½	8	3½ x 3½ x ½
5	16	24	3/8	8	3½ x 3½ x 3/8
6	16	24	½	8	3½ x 3½ x ½
7	16	27	3/8	8	3½ x 3½ x 3/8
8	16	27	½	8	3½ x 3½ x ½
9	16	30	3/8	8	3½ x 3½ x 3/8
10	16	30	½	8	3½ x 3½ x ½
11	16	33	3/8	8	3½ x 3½ x 3/8
12	16	33	½	8	3½ x 3½ x ½
13	16	36	3/8	8	3½ x 3½ x 3/8
14	16	36	½	8	3½ x 3½ x ½
15	20	21	3/8	11	4 x 3½ x 3/8
16	20	21	½	11	4 x 3½ x ½
17	20	24	3/8	11	4 x 3½ x 3/8
18	20	24	½	11	4 x 3½ x ½

THICKNESS OF COVER PLATES IN INCHES.

Number of Section.	Depth of Girder in Inches.	Width of Cover Plates in Inches.	3/8		1/2		5/8		3/4		7/8		1		1 1/8		1 1/4		Width of Cover Plates in Inches.	Depth of Girder in Inches.	Number of Section.
			Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.			
19	27	20	1653	171	1914	188	2179	205	2442	221	2706	238	2970	254	3235	271	3500	288	20	27	19
20	27	20			2179	228	2439	245	2700	261	2961	278	3224	294	3486	311	3748	328	20	27	20
21	30	20	1890	181	2133	204	2476	221	2768	237	3062	254	3355	270	3649	287	3944	204	20	30	21
22	30	20			2493	240	2783	257	3074	273	3364	290	3656	306	3947	323	4240	340	20	30	22
23	33	20	2185	188	2508	221	2830	238	3158	254	3474	271	3797	287	4120	304	4444	321	20	33	23
24	33	20			2820	250	3140	267	3459	283	3779	300	4100	316	4421	333	4742	350	20	33	24
25	36	20	2393	196	2745	213	3096	230	3448	246	3800	263	4156	279	4506	296	4859	313	20	36	25
26	36	20			3159	261	3508	278	3857	294	4206	311	4560	327	4906	344	5257	361	20	36	26
27	24	24			2064	200	2344	220	2624	240	2904	260	3188	280	3467	306	3750	320	24	24	27
28	24	24			2156	230	2435	258	2714	278	2994	298	3274	318	3555	338	3836	358	24	24	28
29	27	24			2410	209	2721	229	3040	249	3355	269	3671	289	3988	309	4305	329	24	27	29
30	27	24			2527	251	2840	271	3154	291	3469	311	3784	331	4100	351	4416	371	24	27	30
31	30	24			2733	218	3082	238	3434	258	3785	278	4136	298	4488	318	4838	338	24	30	31
32	30	24			2878	262	3227	282	3576	302	3926	322	4277	342	4628	362	4979	382	24	30	32
33	33	24			3071	227	3456	247	3842	267	4228	287	4596	307	5002	327	5108	347	24	33	33
34	33	24			3247	272	3631	292	4016	312	4401	332	4767	352	5172	372	5559	392	24	33	34
35	36	24			3584	233	4004	253	4424	273	4834	293	5270	313	5688	323	6111	343	24	36	35
36	36	24			3790	283	4208	303	4627	323	5046	343	5470	365	5385	383	6309	403	24	36	36

STRENGTH AND WEIGHT OF WROUGHT IRON RIVETED GIRDERS.



To find the distributed safe load in net tons, divide the coefficient on opposite page corresponding to the number below by the length of span in feet.

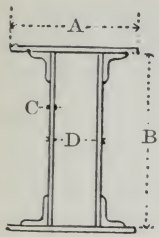
To find the coefficient of strength for a given load and span, multiply the uniformly distributed load in tons by the span in feet between centres of supports.

See opposite page for coefficients.

Number of Section.	*Width of Cover (A) in Inches.*	*Depth of Web (B) in Inches.*	*Thickness of Web (C) in Inches.*	*Width of (D) in Inches.*	*Size of Corner Angles in Inches.*
19	20	27	$\frac{3}{8}$	11	4 x 3½ x $\frac{3}{8}$
20	20	27	½	11	4 x 3½ x ½
21	20	30	$\frac{3}{8}$	11	4 x 3½ x $\frac{3}{8}$
22	20	30	½	11	4 x 3½ x ½
23	20	33	$\frac{3}{8}$	11	4 x 3½ x $\frac{3}{8}$
24	20	33	½	11	4 x 3½ x ½
25	20	36	$\frac{3}{8}$	11	4 x 3½ x $\frac{3}{8}$
26	20	36	½	11	4 x 3½ x ½
27	24	24	$\frac{3}{8}$	13	5 x 4 x $\frac{3}{8}$
28	24	24	½	13	5 x 4 x ½
29	24	27	$\frac{3}{8}$	13	5 x 4 x $\frac{3}{8}$
30	24	27	½	13	5 x 4 x ½
31	24	30	$\frac{3}{8}$	13	5 x 4 x $\frac{3}{8}$
32	24	30	½	13	5 x 4 x ½
33	24	33	$\frac{3}{8}$	13	5 x 4 x $\frac{3}{8}$
34	24	33	½	13	5 x 4 x ½
35	24	36	$\frac{3}{8}$	13	5 x 4 x $\frac{3}{8}$
36	24	36	½	13	5 x 4 x ½

Number of Section.	Depth of Girder in Inches.	Width of Cover Plates in Inches.	THICKNESS OF COVER PLATES IN INCHES. 3/8		1/2		5/8		3/4		7/8		1		1 1/8		1 1/4		Width of Cover Plates in Inches.	Depth of Girder in Inches.	Number of Section.
			Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.	Coefficient of Strength.	Weight in Pounds per Lineal Foot.			
37	30	30			3093	289	3534	264	3974	289	4415	314	4857	339	5300	364	5782	389	30	30	37
38	30	30			3238	283	3678	308	4117	333	4556	358	4998	383	5439	408	5881	433	30	30	38
39	33	30			3446	247	3951	269	4436	294	4922	319	5408	344	5895	374	6382	399	30	33	39
40	33	30			3643	293	4126	317	4610	343	5094	368	5579	393	6065	418	6551	443	30	33	40
41	36	30			4038	254	4543	379	5072	304	5601	329	6136	354	6661	379	7191	404	30	36	41
42	36	30			4222	303	4748	328	5275	353	5803	378	6336	403	6860	428	7389	452	30	36	42
43	39	30			4241	262	4815	287	5389	312	5963	337	6538	362	7114	387	7689	412	30	39	43
44	39	30			4448	314	5060	339	5633	364	6206	389	6779	414	7353	439	7928	464	30	39	44
45	42	30			4642	270	5260	375	5879	320	6681	345	7117	370	7737	395	8357	420	30	42	45
46	42	30			4929	324	5546	349	6123	374	6780	399	7438	424	8016	449	8635	474	30	42	46
47	36	36			4448	275	5004	305	5721	335	6358	365	7002	395	7634	425	8273	455	36	36	47
48	36	36			4654	325	5288	355	5924	385	6560	415	7202	445	7833	475	8470	505	36	36	48
49	39	36			4709	282	5400	312	6091	343	6783	373	7475	403	8168	433	8861	446	36	39	49
50	39	36			4956	336	5646	366	6335	393	7025	423	7716	453	8408	483	8999	563	36	39	50
51	42	36			5165	290	5890	320	6635	350	7380	380	8121	410	8872	440	9627	470	36	42	51
52	42	36			5434	373	6176	403	6917	433	7662	463	8406	493	9151	523	9896	553	36	42	52

STRENGTH AND WEIGHT OF WROUGHT IRON RIVETED GIRDERS.



To find the distributed safe load in net tons, divide the coefficient on opposite page corresponding to the number below by the length of span in feet.

To find the coefficient of strength for a given load and span, multiply the uniformly distributed load in tons by the span in feet between centres of supports.

See opposite page for coefficients.

Number of Section.	*Width of Cover (A) in Inches.*	*Depth of Web (B) in Inches.*	*Thickness of Web (C) in Inches.*	*Width of (D) in Inches.*	*Size of Corner Angles in Inches.*
37	30	30	$\frac{3}{8}$	18	5 x 4 x $\frac{3}{8}$
38	30	30	$\frac{1}{2}$	18	5 x 4 x $\frac{1}{2}$
39	30	33	$\frac{3}{8}$	18	5 x 4 x $\frac{3}{8}$
40	30	33	$\frac{1}{2}$	18	5 x 4 x $\frac{1}{2}$
41	30	36	$\frac{3}{8}$	18	5 x 4 x $\frac{3}{8}$
42	30	36	$\frac{1}{2}$	18	5 x 4 x $\frac{1}{2}$
43	30	39	$\frac{3}{8}$	18	5 x 4 x $\frac{3}{8}$
44	30	39	$\frac{1}{2}$	18	5 x 4 x $\frac{1}{2}$
45	30	42	$\frac{3}{8}$	18	5 x 4 x $\frac{3}{8}$
46	30	42	$\frac{1}{2}$	18	5 x 4 x $\frac{1}{2}$
47	36	36	$\frac{3}{8}$	24	5 x 4 x $\frac{3}{8}$
48	36	36	$\frac{1}{2}$	24	5 x 4 x $\frac{1}{2}$
49	36	39	$\frac{3}{8}$	24	5 x 4 x $\frac{3}{8}$
50	36	39	$\frac{1}{2}$	24	5 x 4 x $\frac{1}{2}$
51	36	42	$\frac{3}{8}$	24	5 x 4 x $\frac{3}{8}$
52	36	42	$\frac{1}{2}$	24	5 x 4 x $\frac{1}{2}$

GENERAL RULE FOR GIRDERS OF ANY SECTION.

Find the moment of inertia of the section as described on page 174, and thence the coefficient of strength for a distributed load in tons, as described on page 137, viz.: coefficient $= \frac{\text{Inertia} \times 8}{\text{depth of girder}}$. Apply as described on page 138. This coefficient gives flange strains of 12,000 lbs. per square inch. If either greater or less flange strains are desired, increase or decrease the coefficient proportionately.

BY FLANGE STRAINS ALONE.

If one-sixth of the web area is added to the area of each flange, and the sum considered as the effective flanges, then the area of one effective flange, multiplied by the distance between effective flange centres, will be the moment of resistance of the girder section. Apply this rule as described on page 130, or

$$\text{distributed load in net tons} = \frac{\frac{2}{3} d f s}{L}$$

d = distance in inches between flange centres.
f = effective area of each flange in square inches.
s = fibre strain allowed in tons per square inch.
L = span of girder in feet.

Example.—Required distributed load for a 20-foot span girder 20 inches deep, flange area 10 square inches, web area 9 square inches—each effective flange = $11\frac{1}{2}$ square inches, distance between flange centres = 19 inches, allowing flange strain of 5 tons.

$$\frac{\frac{2}{3} \times 19 \times 11\frac{1}{2} \times 5}{20} = 36.4 \text{ tons distributed load,}$$

or half this in centre of girder.

ELEMENTS OF PENCOYD STRUCTURAL SHAPES.

In the following tables various fundamental properties of rolled sections are given, whereby the strength or stiffness of each can be readily determined.

The calculations are made accurately for the least and greatest thickness of each shape, but intermediate thicknesses can be approximated by interpolation.

Moments of Inertia for the sections are obtained as hereafter described.

Radius of Gyration equals $\sqrt{\frac{\text{Inertia}}{\text{area}}}$, is used for determining the resistance of struts or columns.

Moment of Resistance equals $\frac{\text{Inertia}}{\text{distance from axis to extreme fibres}}$ is used for determining transverse strength in beams, etc., as described on page 130.

Coefficient for Safe Load is the calculated load in net tons, on a beam one foot between supports, that produces fibre strains of 14,000 lbs. on iron or 16,800 lbs. per square inch on steel. A corresponding load for any beam is found by dividing this coefficient by the length of span in feet.

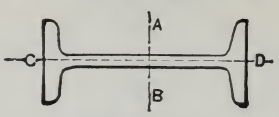
Coefficients for Deflection are found by the formulæ on page 126, based on a modulus of elasticity of 28,000,000 lbs. for steel or iron. They apply to beams one foot long, bearing one ton (2,000 lbs.). The deflection of any beam in inches is found by multiplying its coefficient by the load in tons and by the cube of the length in feet.

Maximum Load in Tons indicates the greatest load in tons that a beam, however short, should carry, unless its web is reinforced, to prevent crippling. This load is obtained by the formula:

$$W = \frac{xdt}{1 + \frac{l^2}{3000d^2}}$$

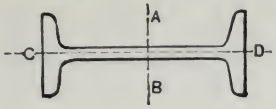
$x = 7$ tons for iron, or 8 tons for steel.
$d =$ depth of beam.
$t =$ thickness of web.
$l = d +$ secant $45°$ ($l^2 = 2d^2$).

ELEMENTS OF PENCOYD BEAMS.



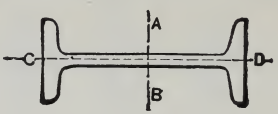
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
Section Number.	*Size in Inches.*	*Area in Square Inches.*	*Weight in Pounds per Foot.*		*Moments of Inertia.*		*Square of Radius of Gyration.*		*Radius of Gyration.*	
			Iron.	*Steel.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*
1	15	19.03	63.43		660.00	26.56	34.69	1.39	5.89	1.18
1	15	23.80	79.33		750.00	32.10	31.47	1.35	5.61	1.16
2	15	14.80	49.33		532.20	16.64	36.00	1.12	6.00	1.06
2	15	18.59	61.96		602.50	19.60	32.38	1.04	5.69	1.02
521	15	12.47		42.39	443.50	14.97	35.52	1.21	5.96	1.10
521	15	15.32		52.08	496.90	16.97	32.38	1.10	5.69	1.05
522	15	14.51		49.32	497.11	19.67	34.25	1.36	5.85	1.16
522	15	16.76		56.98	539.29	21.03	32.11	1.25	5.66	1.12
523	15	16.95		57.63	583.78	26.91	34.44	1.59	5.87	1.26
523	15	20.70		70.38	654.09	31.04	31.60	1.50	5.62	1.22
524	15	20.54		69.80	704.52	37.82	34.30	1.84	5.84	1.35
524	15	25.19		85.64	791.70	44.43	31.43	1.76	5.65	1.33
3	12	17.12	57.06	58.20	375.30	22.77	21.90	1.32	4.68	1.15
3	12	18.92	63.06	64.32	396.90	24.93	20.98	1.32	4.58	1.15
4	12	12.03	40.10	40.90	273.60	12.00	22.75	1.00	4.77	1.00
4	12	14.76	49.20	50.18	306.70	14.02	20.70	0.94	4.55	0.97
515	12	9.01		30.63	207.90	8.90	23.04	0.98	4.80	0.99
515	12	11.24		38.21	233.80	10.06	20.79	0.88	4.56	0.94
516	12	11.95		40.63	274.90	16.61	23.00	1.39	4.79	1.18
516	12	14.35		48.79	303.70	17.08	21.16	1.19	4.49	1.09
5	10½	13.53	45.10	46.00	242.60	18.70	17.89	1.39	4.23	1.18
5	10½	16.16	53.86	54.94	266.70	21.85	16.48	1.35	4.06	1.16
5½	10½	10.96	36.53	37.26	197.00	12.33	17.98	1.12	4.24	1.06
5½	10½	13.58	45.26	46 16	221.10	14.59	16.24	1.06	4.03	1.03
6	10½	9.00	30.00	30.60	163.55	8.26	18.14	0.92	4.26	0.96
6	10½	10.89	36.30	37.03	180.91	9.45	16.56	0.86	4.07	0.93
7	10	11.25	37.50	38.25	174.35	10.53	15.52	0.92	3.94	0.96
7	10	13.75	45.83	46.75	195.18	12.65	14.21	0.92	3.77	0.96
8	10	9.14	30.46	31.07	151.13	8.27	16.56	0.90	4.07	0.95
8	10	10.64	35.46	36.17	163.63	9.26	15.37	0.86	3.92	0.93
511	10	6.83		23.21	112.42	5.70	16.48	0.83	4.06	0.91
511	10	8.83		30.02	129.08	6.62	14.59	0.76	3.82	0.87
9	9	9.28	30.93	31.55	121.94	9.58	13.10	1.02	3.62	1.01
9	9	10.99	36.63	37.36	133.48	10.94	12.11	1.00	3.48	1.00
10	9	7.18	23.93	24.41	96.68	5.80	13.47	0.81	3.67	0.90
10	9	8.89	29.63	30.22	108.22	6.73	12.18	0.76	3.49	0.87
509	9	5.97		20.30	80.78	4.68	13.54	0.77	3.68	0.88
509	9	7.41		25.19	90.50	5.29	12.18	0.71	3.49	0.84

ELEMENTS OF PENCOYD BEAMS.



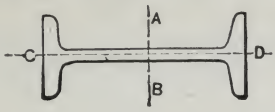
XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	II.
Resistance. Axis A. B.	*Add to Previous Co-eff. for each Additional Pound per Foot.*	*Coefficient in Net Tons for Greatest Safe Load Distributed.*		*Add to Previous Co-eff. for each Additional Pound per Foot.*	*Coefficient for Deflection.*		*Maximum Load in Net Tons.*		*Size in Inches.*
		Iron.	*Steel.*		*Distributed.*	*Centre.*	*Iron.*	*Steel.*	
88.00	0.75	410.61		3.499	.0000024	.0000039	39.78	46.88	15
100.00	"	466.66		"	.0000021	.0000034	77.45	91.28	15
70.96	"	331.14		"	.0000029	.0000048	26.03	30.68	15
80.33	"	374.87		"	.0000026	.0000043	55.10	64.94	15
59.13	"		331.13	"	.0000035	.0000058	22.77	26.84	15
66.25	"		370.99	"	.0000031	.0000052	44.46	52.40	15
66.28	"		364.54	"	.0000032	.0000052	27.14	31.98	15
71.91	"		395.51	"	.0000029	.0000048	44.47	52.41	15
77.83	"		428.07	"	.0000027	.0000044	32.81	38.67	15
87.21	"		479.66	"	.0000024	.0000039	62.17	73.27	15
93.93	"		516.62		.0000022	.0000036	43.29	51.02	15
105.56	"		580.58		.0000020	.0000032	79.73	93.97	15
62.55	0.60	291.90	350.28	2.800	.0000042	.0000068	44.49	52.44	12
66.15	"	308.70	370.44	"	.0000039	.0000065	58.43	68.86	12
45.60	"	212.80	255.36	"	.0000057	.0000094	25.64	30.22	12
51.12	"	238.56	286.27	"	.0000051	.0000084	47.28	55.72	12
34.65	"		194.04		.0000075	.0000124	16.49	19.43	12
38.96	"		218.17		.0000067	.0000110	33.17	39.09	12
45.81	"		251.96	"	.0000057	.0000095	21.00	24.75	12
50.61	"		278.36	"	.0000052	.0000084	39.78	46.88	12
46.21	0.52	215.65	258.78	2.427	.0000065	.0000106	25.92	30.55	10½
50.80	"	237.07	284.48	"	.0000059	.0000096	46.34	54.62	10½
37.52	"	175.09	210.11	"	.0000080	.0000130	20.97	24.71	10½
42.11	"	196.51	235.31	"	.0000071	.0000116	41.49	48.90	10½
31.15	"	145.36	174.43	"	.0000096	.0000157	16.08	18.95	10½
34.46	"	160.81	192.97	"	.0000087	.0000142	30.89	36.41	10½
34.87	0.50	162.72	195.26	2 333	.0000090	.0000147	27.65	32.59	10
39.04	"	182.19	218.63	"	.0000080	.0000132	46.96	55.35	10
30.23	"	141.07	169.28	"	.0000104	.0000170	15.87	18.70	10
32.72	"	152.69	183.23	"	.0000096	.0000157	27.65	32.59	10
22.48	"		125.89	"	.0000139	.0000229	12.06	14.21	10
25.81	"		144.54	"	.0000121	.0000199	27.65	32.59	10
27.10	0.45	126.46	151.75	2.100	.0000129	.0000211	19.55	23.04	9
29.66	"	138.41	166.09	"	.0000117	.0000193	32-87	38.74	9
21.48	"	100.24	120.29	"	.0000162	.0000266	12.50	14.73	9
24.05	"	112.23	134.68	"	.0000145	.0000238	25.90	30.53	9
17.95	"		100.52	"	.0000194	.0000318	10.44	12.30	9
20.11	"		112.61	"	.0000173	.0000284	21.67	25.54	9

ELEMENTS OF PENCOYD BEAMS.



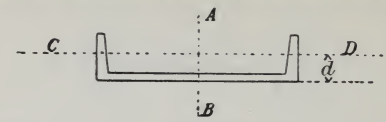
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
Section Number.	*Size in Inches.*	*Area in Square Inches.*	*Weight in Pounds per Foot.*		*Moments of Inertia.*		*Square of Radius of Gyration.*		*Radius of Gyration.*	
			Iron.	*Steel.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*
11	8	8.26	27.53	28.08	84.80	7.38	10.24	0.90	3.20	0.95
11	8	9.78	32.60	33.25	92.91	8.54	9.49	0.86	3.08	0.93
12	8	6.24	20.80	21.22	66.83	4.50	10.69	0.72	3.27	0.85
12	8	7.84	26.13	26.65	75.36	5.32	9.61	0.67	3.10	0.82
507	8	5.08	16.93	17.27	54.31	3.49	10.69	0.69	3.27	0.83
507	8	6.20	20.66	21.07	60.28	3.92	9.73	0.64	3.12	0.80
13	7	6.68	22.26	22.70	50.40	4.10	7.56	0.60	2.75	0.78
13	7	7.10	23.67	24.14	52.11	4.32	7.34	0.60	2.71	0.78
14	7	5.26	17.53	17.88	44.60	3.42	8.45	0.66	2.91	0.81
14	7	6.66	22.20	22.64	50.32	4.10	7.56	0.60	2.75	0.78
505	7	4.25	14.16	14.44	35.25	2.66	8.29	0.62	2.88	0.79
505	7	5.23	17.43	17.78	39.25	3.00	7.51	0.58	2.74	0.76
23	6	11.79	39.30	40.08	64.07	17.95	5.43	1.51	2.33	1.23
23	6	13.29	44.30	45.19	68.57	20.95	5.15	1.59	2.27	1.26
24	6	9.27	30.90	31.52	52.53	11.59	5.66	1.25	2.38	1.12
24	6	10.77	35.90	36.62	57.03	13.68	5.29	1.28	2.30	1.13
15	6	5.65	18.83	19.21	34.24	4.30	6.05	0.76	2.46	0.87
15	6	7.75	25.83	26.35	40.54	5.78	5.24	0.74	2.29	0.86
16	6	4.10	13.66	13.93	25.42	2.40	6.20	0.58	2.49	0.76
16	6	5.42	18.06	18.42	29.38	2.95	5.43	0.55	2.33	0.74
503	6	3.51	11.70	11.93	21.14	1.82	6.00	0.52	2.45	0.72
503	6	4.47	14.90	15.20	24.02	2.11	5.38	0.48	2.32	0.69
17	5	3.03	10.10	10.30	12.20	1.20	4.00	0.40	2.00	0.63
17	5	3.58	11.93	12.17	13.34	1.37	3.72	0.38	1.93	0.62
18	5	2.73	9.10	9.28	11.58	1.13	4.45	0.41	2.11	0.64
18	5	3.58	11.93	12.17	13.34	1.37	3.72	0.38	1.93	0.62
19	4	2.50	8.33	8.50	6.60	0.84	2.62	0.34	1.62	0.58
19	4	3.38	11.26	11.48	7.77	1.11	2.31	0.32	1.52	0.57
20	4	1.84	6.13	6.25	5.02	0.49	2.72	0.27	1.65	0.52
20	4	2.44	8.13	8.29	5.82	0.60	2.37	0.25	1.54	0.50
21	3	2.06	6.86	7.00	2.99	0.62	1.44	0.30	1.20	0.55
21	3	2.72	9.06	9.24	3.48	0.85	1.28	0.31	1.13	0.56
22	3	1.58	5.26	5.37	2.41	0.40	1.51	0.25	1.23	0.50
22	3	2.03	6.76	6.90	2.75	0.50	1.35	0.25	1.16	0.50

ELEMENTS OF PENCOYD BEAMS.



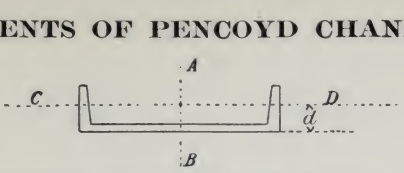
XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	II.
Resistance. Axis A. B.	*Add to Previous Coeff. for each Additional Pound per Foot.*	*Coefficient in Net Tons for Greatest Safe Load Distributed.*		*Add to Previous Coeff. for each Additional Pound per Foot.*	*Coefficient for Deflection.*		*Maximum Load in Net Tons.*		*Size in Inches.*
		Iron.	*Steel.*		*Distributed.*	*Centre.*	*Iron.*	*Steel.*	
21.20	0.40	98.93	118.72	1.866	.0000185	.0000303	18.32	21.59	8
23.23	"	108.41	130.092	"	.0000169	.0000277	30.05	35.41	8
16.71	"	77.98	93.58	"	.0000235	.0000385	11.40	13.43	8
18.84	"	87.92	105.50	"	.0000208	.0000341	23.91	28.18	8
13.58	"	63.37	76.04	"	.0000290	.0000473	8.93	10.52	8
15.06	"	70.28	84.34	"	.0000260	.0000426	17.68	20.84	8
14.40	0.35	67.20	80.64	1.633	.0000311	.0000510	18.44	21.73	7
14.89	"	69.49	83.39	"	.0000301	.0000493	21.66	25.53	7
12.74	"	59.45	71.34	"	.0000351	.0000576	7.50	8.84	7
14.37	"	67.06	80.47	"	.0000311	.0000511	18.44	21.73	7
10.07	"	46.99	56.39	"	.0000445	.0000734	7.50	8.84	7
11.21	"	52.31	62.77	"	.0000399	.0000655	15.19	17.90	7
21.36	0.30	99.68	119.62	1.400	.0000245	.0000401	24.96	29.42	6
22.86	"	106.68	128.02	"	.0000228	.0000375	35.85	42.25	6
17.51	"	81.71	98.05	"	.0000299	.0000489	19.16	22.58	6
19.01	"	88.71	106.45	"	.0000275	.0000451	30.23	35.63	6
11.41	"	53.25	63.90	"	.0000458	.0000751	9.00	10.61	6
13.51	"	63.05	75.66	"	.0000387	.0000634	24.96	29.42	6
8.47	0.30	39.53	47.44	1.400	.0000610	.0001011	6.18	7.28	6
9.79	"	45.69	54.83	"	.0000533	.0000875	16.44	19.38	6
7.05	"	32.90	39.48	"	.0000741	.0001216	6.18	7.28	6
8.01	"	37.38	44.87	"	.0000652	.0001070	13.69	16.13	6
4.88	0.25	22.77	27.32	1.166	.0001285	.0002107	7.30	8.60	5
5.34	"	24.92	29.90	"	.0001175	.0001927	11.54	13.60	5
4.63	"	21.61	25.93	"	.0001354	.0002200	4.94	5.82	5
5.34	"	24.92	29.90	"	.0001175	.0001927	11.54	13.60	5
3.30	0.20	15.40	18.48	0.933	.0002375	.0003896	5.05	5.95	4
3.89	"	18.15	21.78	"	.0002017	.0003308	11.68	13.76	4
2.51	"	11.71	14.05	"	.0003122	.0005120	3.16	3.72	4
2.91	"	13.58	16.30	"	.0002693	.0004417	7.81	9.20	4
1.99	0.15	9.29	11.15	0.700	.0005241	.0008598	4.11	4.84	3
2.32	"	10.83	13.00	"	.0004505	.0007386	8.96	10.56	3
1.61	"	7.51	9.01	"	.0006502	.0010661	2.72	3.20	3
1.83	"	8.54	10.25	"	.0005699	.0009346	6.13	7.22	3

ELEMENTS OF PENCOYD CHANNELS.



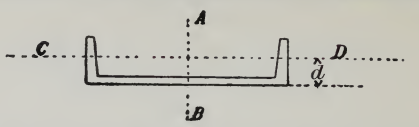
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
Section Number.	*Size in Inches.*	*Area in Square Inches.*	*Weight in Pounds per Foot.*		*Moments of Inertia.*		*Square of Radius of Gyration.*		*Radius of Gyration.*		*Distance "d" from Base to Neutral Axis.*
			Iron.	*Steel.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	
30	15	14.11	47.03	48.00	441.59	16.75	31.29	1.19	5.59	1.09	0.99
30	15	20.68	68.93	70.31	564.78	23.15	27.31	1.12	5.22	1.06	1.04
53	15	10.60	35.33	36.00	358.43	13.16	33.81	1.24	5.81	1.11	0.99
53	15	14.35	47.83	48.80	428.74	16.64	29.89	1.16	5.47	1.08	0.95
55	13	8.84	29.47	30.10	221.25	10.51	25.03	1.19	5.00	1.09	0.96
55	13	12.09	40.30	41.10	267.02	13.30	22.09	1.10	4.70	1.05	0.92
31	12	8.91	29.70	30.30	184.59	6.11	20.72	0.69	4.55	0.83	0.80
31	12	16.04	53.47	54.50	270.12	10.93	16.84	0.68	4.10	0.82	0.90
54	12	6.71	22.37	22.80	136.31	5.20	20.31	0.77	4.51	0.88	0.77
54	12	10.08	33.60	34.30	176.81	7.02	17.54	0.70	4.19	0.84	0.73
427	12	6.27	20.90	21.30	135.68	4.93	21.64	0.79	4.65	0.89	0.77
427	12	9.65	32.17	32.80	176.18	6.77	18.26	0.70	4.27	0.84	0.73
32	12	6.02	20.07	20.50	126.10	3.09	20.94	0.51	4.57	0.72	0.63
32	12	9.40	31.33	31.96	166.60	4.41	17.72	0.47	4.21	0.68	0.63
33½	10½	7.09	23.63	24.11	102.63	4.98	14.47	0.70	3.80	0.84	0.73
33½	10½	7.75	25.83	26.30	108.66	5.38	14.02	0.69	3.74	0.83	0.73
33	10½	5.27	17.57	17.92	77.40	3.90	14.68	0.74	3.83	0.86	0.69
33	10½	5.93	19.77	20.20	83.43	4.29	14.07	0.72	3.75	0.85	0.68
34	10	6.14	20.47	20.90	90.24	3.76	14.70	0.61	3.83	0.78	0.73
34	10	10.36	34.53	35.20	125.40	5.96	12.10	0.57	3.48	0.76	0.76
35	10	4.82	16.07	16.40	72.79	2.49	15.10	0.52	3.89	0.72	0.66
35	10	6.72	22.40	22.85	88.42	3.30	13.16	0.49	3.63	0.70	0.63
36	9	5.17	17.23	17.60	61.18	2.75	11.83	0.53	3.44	0.73	0.67
36	9	8.55	28.50	29.07	83.99	4.26	9.82	0.50	3.13	0.70	0.70
37	9	3.81	12.70	13.00	45.56	1.64	11.96	0.43	3.46	0.66	0.57
37	9	5.64	18.80	19.18	57.90	2.20	10.27	0.39	3.20	0.62	0.56
418	8	4.05	13.50	13.80	39.65	2.10	9.79	0.52	3.13	0.72	0.68
418	8	6.05	20.17	20.60	50.31	2.97	8.32	0.49	2.88	0.70	0.66
419	8	3.22	10.73	11.00	30.69	1.27	9.53	0.39	3.09	0.63	0.55
419	8	4.47	14.90	15.20	37.36	1.65	8.36	0.37	2.89	0.61	0.53

ELEMENTS OF PENCOYD CHANNELS.



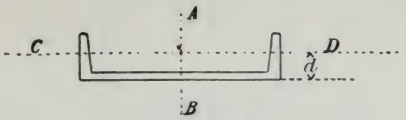
XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	II.
Resistance, Axis A. B.	*Add to Previous Coeff. for each Additional Pound per Foot.*	*Coefficient in Net Tons for Greatest Safe Load Distributed.*		*Add to Previous Coeff. for each Additional Pound per Foot.*	*Coefficient for Deflection.*		*Maximum Load in Net Tons.*		*Size in Inches.*
		Iron.	*Steel.*		*Distributed.*	*Centre.*	*Iron.*	*Steel.*	
55.88	0.75	274.77	329.72	3.50	.0000035	.0000058	40.01	47.16	15
75.30	"	351.40	421.68	"	.0000028	.0000046	91.30	107.61	15
47.79	"	223.02	267.62	"	.0000044	.0000072	19.06	22.46	15
57.16	"	266.78	320.14	"	.0000037	.0000060	47.42	55.89	15
34.04	0.65	158.84	190.61	3.03	.0000071	.0000116	18.95	22.33	13
41.08	"	191.70	230.04	"	.0000059	.0000096	44.14	52.02	13
30.76	0.60	143.37	172.04	2.80	.0000085	.0000139	21.58	25.43	12
45.02	"	210.09	252.11	"	.0000058	.0000095	76.64	90.33	12
22.72	"	106.02	127.22	"	.0000115	.0000189	10.67	12.58	12
29.47	"	137.53	165.04	"	.0000088	.0000145	36.26	42.74	12
22.61	0.60	105.53	126.64	2.80	.0000116	.0000189	10.67	12.58	12
29.36	"	137.01	164.41	"	.0000089	.0000146	36.26	42.74	12
21.02	"	98.05	117.66	"	.0000124	.0000204	10.67	12.58	12
27.77	"	129.58	155.50	"	.0000094	.0000155	36.26	42.74	12
19.55	0.52	91.23	109.47	2.43	.0000153	.0000250	23.29	27.43	10½
20.70	"	96.60	115.92	"	.0000144	.4000237	28.41	33.48	10½
14.74	"	68.79	82.55	"	.0000202	.0000332	13.05	15.37	10½
15.89	"	74.15	88.98	"	.0000188	.0000308	18.11	21.34	10½
18.05	0.50	84.23	101.08	2.33	.0000174	.0000285	14.17	16.70	10
25.08	"	117.04	140.45	"	.0000125	.0000205	46.90	55.28	10
14.56	"	67.95	81.54	"	.0000215	.0000353	8.47	9.98	10
17 68	"	82.54	99.05	"	.0000170	.0000291	22.70	26.75	10
13.59	0.45	63.45	76.14	2.10	.0000257	.0000420	12.67	14.93	9
18.66	"	87.09	104.51	"	.0000187	.0000306	39.00	45.97	9
10.12	"	47.24	56.69	"	.0000344	.0000564	7.45	8.78	9
12.87	"	60.05	72.06	"	.0000271	.0000444	21.62	25.48	9
9.91	0.40	46.25	55.50	1.87	.0000395	.0000648	8.32	9.81	8
12.58	"	58.70	70.44	"	.0000312	.0000511	23.93	28.20	8
7.67	"	35.80	42.96	"	.0000511	.0000838	6.47	7.63	8
9.34	"	43.58	52.30	"	.0000420	.0000688	16.11	18.99	8

ELEMENTS OF PENCOYD CHANNELS.



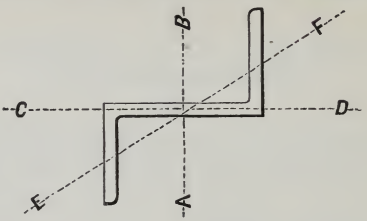
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
Section Number.	*Size in Inches.*	*Area in Square Inches.*	*Weight in Pounds per Foot.*		*Moments of Inertia.*		*Square of Radius of Gyration.*		*Radius of Gyration.*		*Distance "d" from Base to Neutral Axis.*
			Iron.	*Steel.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	
40	7	4.11	13.70	14.00	29.74	1.73	7.24	0.42	2.69	0.65	0.65
40	7	7.29	24.30	24.80	42.72	3.06	5.86	0.42	2.42	0.65	0.72
417	7	2.64		9.00	19.03	0.92	7.21	0.35	2.68	0.59	0.51
417	7	4.11		14.00	25.03	1.28	6.09	0.31	2.47	0.55	0.50
41	7	2.47	8.23	8.40	18.83	0.81	7.62	0.33	2.76	0.57	0.53
41	7	4.33	14.43	14.72	26.43	1.30	6.10	0.30	2.47	0.55	0.51
42	6	3.22	10.73	11.00	17.77	1.38	5.52	0.43	2.35	0.65	0.65
42	6	5.47	18.23	18.60	24.52	2.30	4.48	0.42	2.12	0.65	0.63
44	6	2.31	7.70	7.90	12.38	0.58	5.36	0.25	2.31	0.50	0.48
44	6	3.35	11.17	11.39	15.47	0.82	4.62	0.25	2.15	0.50	0.47
415	6	2.21		7.50	11.77	0.67	5.33	0.30	2.31	0.55	0.49
415	6	3.41		11.60	18.70	0.94	5.48	0.27	2.34	0.52	0.48
412	5	2.47	8.23	8.40	9.39	0.91	3.80	0.37	1.95	0.60	0.60
412	5	3.64	12.13	12.40	11.83	1.31	3.25	0.36	1.82	0.60	0.60
413	5	1.80		6.12	6.73	0.47	3.74	0.26	1.93	0.51	0.47
413	5	2.75		9.35	8.70	0.67	3.16	0.24	1.78	0.49	0.46
47	4	2.16	7.20	7.30	5.07	0.52	2.35	0.24	1.53	0.49	0.53
47	4	3.16	10.53	10.70	0.40	0.81	2.02	0.26	1.42	0.51	0.57
48	4	1.65	5.50	5.60	3.99	0.34	2.42	0.21	1.55	0.46	0.47
48	4	2.15	7.17	7.30	4.66	0.45	2.17	0.21	1.47	0.46	0.47
411	4	1.52		5.16	3.70	0.33	2.43	0.22	1.56	0.46	0.46
411	4	2.24		7.60	4.66	0.48	2.08	0.21	1.44	0.46	0.46
49	3	1.53	5.10	5.20	2.04	0.22	1.33	0.14	1.15	0.38	0.51
49	3	1.81	6.03	6.15	2.50	0.39	1.38	0.22	1.18	0.46	0.52
50	2¼	1.13	3.77	3.84	0.80	0.19	0.71	0.17	0.84	0.41	0.47
51	2	0.87	2.90	2.96	0.48	0.08	0.55	0.09	0.74	0.30	0.37
51	2	1.06	3.53	3.60	0.54	0.11	0.51	0.10	0.71	0.32	0.39
52	1¾	0.34	1.13	1.15	0.15	0.00	0.44		0.67		0.18

ELEMENTS OF PENCOYD CHANNELS.



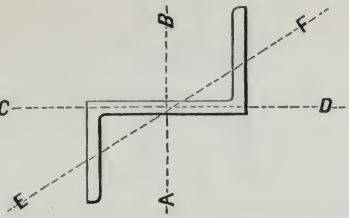
XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	II.
Resistance. Axis A. B.	*Add to Previous Coeff. for each Additional Pound per Foot.*	*Coefficient in Net Tons for Greatest Safe Load Distributed.*		*Add to Previous Coeff. for each Additional Pound per Foot.*	*Coefficient for Deflection.*		*Maximum Load in Net Tons.*		*Size in Inches.*
		Iron.	*Steel.*		*Distributed.*	*Centre.*	*Iron.*	*Steel.*	
8.50	0.35	39.66	47.59	1.633	.0000527	.0000864	10.62	12.52	7
12.20	"	56.98	68.38	"	.0000367	.0000602	34.73	40.93	7
5.43	"		30.41	"	.0000824	.0001351	5.91	6.97	7
7.15	"		40.04	"	.0000626	.0001027	17.37	20.47	7
5.38	"	25.11	30.13	"	.0000832	.0001365	4.00	4.71	7
7.55	"	35.23	42.28	"	.0000593	.0000973	18.30	21.57	7
5.92	0.30	27.63	33.16	1.400	.0000882	.0001446	7.60	8.96	6
8.17	"	38.14	45.77	"	.0000639	.0001048	24.73	29.15	6
4.13	"	19.26	23.11	"	.0001266	.0002076	5.40	6.35	6
5.16	"	24.07	28.88	"	.0001013	.0001662	13.45	15.82	6
3.92	"		21.96	"	.0001332	.0002184	5.25	6.19	6
6.23	"		34 90	"	.0000838	.0001375	14.60	17.21	6
3.76	0.25	17.54	21.05	1.166	.0001669	.0002738	6.29	7.40	5
4.73	"	22.08	26.50	"	.0001325	.0002173	15.25	17.97	5
2.69	"		15.07	"	.0002329	.0003820	4.55	5.36	5
3.48	"		19.49	"	.0001802	.0002955	11.92	14.02	5
2.53	0.20	11.84	14.11	0.933	.0003092	.0005070	5.98	7.05	4
3.20	"	14.93	17.92	"	.0002449	.0004017	13.43	15.83	4
1.99	"	9.31	11.17	"	.0003928	.0006443	4.03	4.75	4
2.33	"	10.87	13.04	"	.0003364	.0005517	7.89	9.30	4
1.85	"		10.36	"	.0004236	.0006948	3.79	4.47	4
2.33	"		13.04	"	.0003364	.0005517	5.53	6.52	4
1.36	0.15	6.35	7.62	0.700	.0007684	.0012601	4.08	4.81	3
1.67	"	7.77	9.32	"	.0006270	.0010283	6.18	7.28	3
0.71	0.11	3.31	3.97	0.522	.0019593	.0032133	2.56	3.02	2¼
0.48	0.10	2.24	2.69	0.466	.0032654	.0053556	2.90	3.42	2
0.54	"	2.52	3.02	"	.0029025	.0047605	4.26	5.02	2
0.17	0.09	0.79	0.95	0.406	.0104493	.0171371	0.93	1.10	1¼

ELEMENTS OF PENCOYD Z BARS.



Section Number.	Size in Inches.	Area in Square Inches.	Weight per Foot in Pounds.		Moments of Inertia.		Resistance.	
			Iron.	Steel.	Axis A. B.	Axis C. D.	Axis A. B.	Axis C. D.
220	$2\frac{5}{8}$ x 3 x $2\frac{5}{8}$ x $\frac{1}{4}$	1.94	6.47	6.60	2.81	2.61	1.87	1.04
220	$2\frac{3}{4}$ x $3\frac{1}{8}$ x $2\frac{3}{4}$ x $\frac{3}{8}$	2.94	9.80	10.00	4.34	4.22	2.70	1.65
221	$2\frac{21}{32}$ x 3 x $2\frac{21}{32}$ x $\frac{7}{16}$	3.28	10.93	11.15	4.20	4.24	2.80	1.74
221	$2\frac{23}{32}$ x $3\frac{1}{16}$ x $2\frac{23}{32}$ x $\frac{1}{2}$	3.75	12.50	12.75	4.89	5.04	3.19	2.04
222	$2\frac{7}{8}$ x 4 x $2\frac{7}{8}$ x $\frac{1}{4}$	2.32	7.73	7.88	5.95	3.47	2.98	1.26
222	3 x $4\frac{1}{8}$ x 3 x $\frac{3}{8}$	3.50	11.67	11.90	9.14	5.58	4.43	1.98
223	$2\frac{31}{32}$ x 4 x $2\frac{31}{32}$ x $\frac{7}{16}$	3.96	13.20	13.46	9.40	6.09	4.70	2.21
223	$3\frac{3}{32}$ x $4\frac{1}{8}$ x $3\frac{3}{32}$ x $\frac{9}{16}$	5.16	17.20	17.54	12.40	8.40	6.01	2.99
224	$3\frac{1}{16}$ x 4 x $3\frac{1}{16}$ x $\frac{5}{8}$	5.53	18.43	18.80	12.11	8.73	6.06	3.17
224	$3\frac{3}{16}$ x $4\frac{1}{8}$ x $3\frac{3}{16}$ x $\frac{3}{4}$	6.75	22.50	22.95	14.97	11.24	7.26	4.00
225	$3\frac{3}{16}$ x 5 x $3\frac{3}{16}$ x $\frac{5}{16}$	3.36	11.20	11.42	13.14	5.81	5.26	1.92
225	$3\frac{5}{16}$ x $5\frac{1}{8}$ x $3\frac{5}{16}$ x $\frac{7}{16}$	4.75	15.83	16.15	18.76	8.67	7.32	2.80
226	$3\frac{7}{32}$ x 5 x $3\frac{7}{32}$ x $\frac{1}{2}$	5.23	17.43	17.78	19.03	8.77	7.61	2.95
226	$3\frac{11}{32}$ x $5\frac{1}{8}$ x $3\frac{11}{32}$ x $\frac{5}{8}$	6.60	22.00	22.44	24.33	11.70	9.49	3.86
227	$3\frac{1}{2}$ x 5 x $3\frac{1}{2}$ x $\frac{11}{16}$	6.96	23.20	23.66	23.68	11.37	9.47	3.91
227	$3\frac{5}{16}$ x $5\frac{1}{16}$ x $3\frac{5}{16}$ x $\frac{3}{4}$	7.64	25.46	25.97	26.16	12.83	10.34	4.36
228	$3\frac{1}{2}$ x 6 x $3\frac{1}{2}$ x $\frac{3}{8}$	4.59	15.30	15.61	25.32	9.11	8.44	2.75
228	$3\frac{5}{8}$ x $6\frac{1}{8}$ x $3\frac{5}{8}$ x $\frac{1}{2}$	6.19	20.63	21.05	34.36	12.87	11.22	3.81
229	$3\frac{1}{2}$ x 6 x $3\frac{1}{2}$ x $\frac{9}{16}$	6.68	22.27	22.71	34.64	12.59	11.55	3.91
229	$3\frac{5}{8}$ x $6\frac{1}{8}$ x $3\frac{5}{8}$ x $\frac{11}{16}$	8.25	27.50	28.05	43.18	16.34	14.10	4.98
230	$3\frac{1}{2}$ x 6 x $3\frac{1}{2}$ x $\frac{3}{4}$	8.64	28.80	29.37	42.12	15.44	14.04	4.94
230	$3\frac{5}{8}$ x $6\frac{1}{8}$ x $3\frac{5}{8}$ x $\frac{7}{8}$	10.16	33.86	34.54	50.22	19.18	16.40	6.02

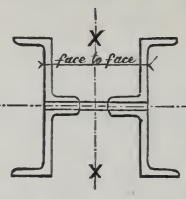
ELEMENTS OF PENCOYD Z BARS.



Radii of Gyration.			Coefficient in Net Tons for Greatest Safe Load Distributed.		Coefficient for Deflection About Axis A. B.		Maximum Load in Net Tons.		Section Number.
Axis A. B.	Axis C. D.	Least Axis E. F.	Iron.	Steel.	Centre.	Distributed.	Iron.	Steel.	
1.20	1.16	0.52	8.72	10.46	.0009148	.0005578	4.79	5.65	220
1.21	1.20	0.57	12.97	15.56	.0003612	.0003612	7.87	9.28	220
1.13	1.14	0.54	13.06	15.67	.0006121	.0003732	8.91	10.50	221
1.14	1.16	0.57	14.88	17.86	.0005257	.0003205	10.46	12.33	221
1.60	1.22	0.63	13.90	16.68	.0004320	.0002634	5.97	7.04	222
1.61	1.26	0.65	20.67	24.80	.0002813	.0001715	10.02	11.80	222
1.54	1.24	0.64	21.93	26.32	.0002735	.0001667	11.60	13.67	223
1.55	1.28	0.65	28.04	33.65	.0002073	.0001264	15.68	18.48	223
1.48	1.25	0.75	28.28	33.94	.0002123	.0001294	17.03	20.07	224
1.49	1.29	0.66	33.88	40.66	.0001717	.0001050	21.23	25.02	224
1.98	1.33	0.72	24.54	29.45	.0001956	.0001193	10.75	12.67	225
1.99	1.35	0.74	34.16	40.99	.0001370	.0000836	14.47	17.05	225
1.91	1.30	0.73	35.51	42.61	.0001351	.0000824	16.41	19.34	226
1.92	1.33	0.75	44.28	53.14	.0001057	.0000644	21.45	25.28	226
1.84	1.28	0.73	44.19	53.02	.0001086	.0000662	23.25	27.38	227
1.85	1.30	0.74	48.25	57.90	.0000983	.0000599	25.84	30.46	227
2.35	1.41	0.83	39.38	47.26	.0001015	.0000619	13.46	15.86	228
2.36	1.44	0.84	52.36	62.83	.0000748	.0000456	19.48	22.96	228
2.28	1.37	0.80	53.90	64.68	.0000742	.0000452	21.97	25.89	229
2.29	1.41	0.83	65.80	78.96	.0000595	.0000363	27.54	32.46	229
2.21	1.34	0.80	65.52	78.62	.0000610	.0000372	30.21	35.61	230
2.22	1.37	0.82	76.53	91.84	.0000512	.0000312	36.33	42.82	230

ELEMENTS OF Z BAR COLUMNS.

I = Mom. of Inertia.

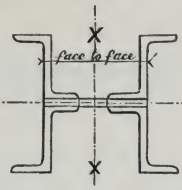


R = Rad. of Gyration.

THE THICKNESS OF WEB PLATE AND Z BAR IS THE SAME.

Size of Z Bar in Inches.	7″ Web Plate. 7¼″ Face to Face.					7½″ Web Plate. 7¾″ Face to Face.				
	Area of 4 Z Bars and 1 Plate	Axis XX.		Axis YY.		Area of 4 Z Bars and 1 Plate	Axis XX.		Axis YY.	
		I.	R².	I.	R².		I.	R².	I.	R².
3½ x6 x3½ x⅜	20.99	264.18	12.59	287.91	13.72	21.17	299.34	14.14	287.91	13.60
3 9/16 x6 1/16 x3 9/16 x 7/16	24.62	306.41	12.45	346.95	14.09	24.84	347.30	13.98	346.95	13.97
3⅝ x6⅛ x3⅝ x½	28.26	347.81	12.31	409.27	14.48	28.51	392.86	13.78	409.28	14.36
3¾ x6 x3¾ x 9/16	30.66	365.24	11.91	426.30	13.90	30.94	415.23	13.42	426.31	13.78
3 9/16 x6 1/16 x3 9/16 x⅝	34.22	403.02	11.78	489.32	14.30	34.53	458.45	13.28	489.33	14.17
3⅝ x6⅛ x3⅝ x 11/16	37.81	440.25	11.64	555.79	14.70	38.16	500.93	13.13	455.80	14.57
3¾ x6 x3¾ x¾	39.81	448.24	11.26	562.41	14.13	40.19	511.45	12.73	562.42	13.99
3 9/16 x6 1/16 x3 9/16 x 13/16	43.21	481.06	11.13	628.31	14.54	43.61	549.08	12.59	628.33	14.41
3⅝ x6⅛ x3⅝ x⅞	46.77	514.73	11.00	699.07	14.95	47.20	587.80	12.45	699.10	14.81
	6½″ Web Plate. 6¾″ Face to Face.					7″ Web Plate. 7¼″ Face to Face.				
3 3/16 x5 x3 3/16 x 5/16	15.47	169.65	10.97	147.39	9.53	15.63	193.91	12.41	147.39	9.43
3¼ x5 1/16 x3¼ x⅜	18.64	202.04	10.84	183.47	9.84	18.83	231.00	12.27	183.47	9.74
3 5/16 x5⅛ x3 5/16 x 7/16	21.84	233.93	10.71	223.00	10.21	22.06	267.61	12.13	223.00	10.11
3 5/16 x5 x3 5/16 x½	24.17	249.97	10.34	234.39	9.70	24.42	287.67	11.78	234.39	9.60
3 9/32 x5 1/16 x3 9/32 x 9/16	27.30	279.93	10.25	273.72	10.03	27.58	321.22	11.65	273.72	9.93
3 11/32 x5⅛ x3 11/32 x⅝	30.46	308.80	10.14	315.55	10.36	30.78	354.42	11.52	315.56	10.25
3¼ x5 x3¼ x 11/16	32.31	316.97	9.81	320.08	9.91	32.65	364.83	11.17	320.09	9.80
3 5/16 x5 1/16 x3 5/16 x¾	35.44	343.48	9.69	362.93	10.24	35.81	395.52	11.04	362.95	10.14
	6″ Web Plate. 6¼″ Face to Face.					6½″ Web Plate. 6¾″ Face to Face.				
2⅞ x4 x2⅞ x¼	10.78	101.90	9.45	65.72	6.10	10.91	117.62	10.78	65.72	6.02
2 5/16 x4 1/16 x2 5/16 x 5/16	13.52	126.20	9.34	85.86	6.35	13.67	145.72	10.66	85.86	6.28
3 x4⅛ x3 x⅜	16.25	149.91	9.23	107.47	6.61	16.44	173.18	10.53	107.47	6.54
2 3/16 x4 x2 3/16 x 7/16	18.47	166.01	8.99	115.63	6.26	18.68	192.14	10.29	115.64	6.19
3 1/32 x4 1/16 x3 1/32 x½	21.24	188.60	8.88	138.44	6.52	21.49	218.39	10.16	138.45	6.44
3 3/32 x4⅛ x3 3/32 x 9/16	24.02	210.67	8.77	163.09	6.79	24.30	244.05	10.04	163.10	6.71
3 1/16 x4 x3 1/16 x⅝	25.87	221.21	8.55	166.90	6.45	26.18	256.76	9.83	166.91	6.39
3⅛ x4 1/16 x3⅛ x 11/16	28.69	242.12	8.44	192.70	6.72	29.03	281.15	9.69	192.70	6.64
3 3/16 x4⅛ x3 3/16 x¾	31.50	262.65	8.32	220.68	7.01	31.88	305.12	9.57	220.70	6.92
	5½″ Web Plate. 5¾″ Face to Face.					6″ Web Plate. 6¼″ Face to Face.				
2⅝ x3 x2⅝ x¼	9.14	72.59	7.94	31.74	3.47	9.26	84.82	9.16	31.74	3.43
2 1/16 x3 1/16 x2 1/16 x 5/16	11.48	90.17	7.85	42.14	3.67	11.64	105.31	9.05	42.15	3.62
2¾ x3⅛ x2¾ x⅜	13.82	107.05	7.75	53.40	3.86	14.01	125.14	8.93	53.41	3.81
2 7/16 x3 x2 7/16 x 7/16	15.53	115.58	7.44	55.61	3.58	15.75	135.63	8.61	55.61	3.53
2 3/32 x3 1/16 x2 3/32 x½	17.75	130.45	7.35	67.20	3.79	18.00	153.14	8.51	67.20	3.73

ELEMENTS OF Z BAR COLUMNS.



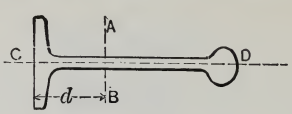
I = Mom. of Inertia. R = Rad. of Gyration.

THE THICKNESS OF WEB PLATE AND Z BAR IS THE SAME.

Size of Z Bar in Inches.	Area of 4 Z Bars and 1 Plate	Axis XX. I.	Axis XX. R^2.	Axis YY. I.	Axis YY. R^2.
8″ Web Plate. 8¼″ Face to Face.					
3½ x6 x3½ x⅜	21.36	337.17	15.78	287.92	13.48
3 9/16 x6 1/16 x3 9/16 x 7/16	25.06	391.37	15.62	346.96	13.85
3⅜ x6⅛ x3⅜ x½	28.76	444.57	15.46	409.28	14.23
3½ x6 x3½ x 9/16	31.22	469.16	15.03	426.32	13.65
3 9/16 x6 1/16 x3 9/16 x⅝	34.84	518.19	14.88	489.34	14.05
3⅝ x6⅛ x3⅜ x 11/16	38.50	566.43	14.72	555.82	14.44
3½ x6 x3½ x¼	40.56	579.76	14.29	562.44	13.87
3 9/16 x6 1/16 x3 9/16 x 13/16	44.02	622.59	14.14	628.36	14.27
3⅝ x6⅛ x3⅜ x 7/8	47.64	666.83	14.00	699.13	14.67
7½″ Web Plate. 7¾″ Face to Face.					
3 3/16 x5 x3 3/16 x 5/16	15.78	220.13	13.95	147.39	9.35
3¼ x5 1/16 x3¼ x⅜	19.01	262.32	13.80	183.47	9.65
3 5/16 x5⅛ x3 5/16 x 7/16	22.28	303.96	13.64	223.00	10.01
3 7/32 x5 x3 7/32 x½	24.67	327.56	13.28	234.40	9.50
3 9/32 x5 1/16 x3 9/32 x 9/16	27.86	365.87	13.13	273.73	9.83
3 11/32 x5⅛ x3 11/32 x⅝	31.09	403.93	12.99	315.57	10.15
3½ x5 x3½ x 13/16	33.00	416.75	12.63	320.10	9.70
3 5/16 x5 1/16 x3 5/16 x¼	36.19	452.01	12.49	362.96	10.03
7″ Web Plate. 7¼″ Face to Face.					
2 7/32 x4 x2 7/32 x¼	11.03	134.71	12.21	65.72	5.96
2 15/32 x4 1/16 x2 15/32 x 15/16	13.83	166.97	12.07	85.86	6.21
3 x4⅛ x3 x⅜	16.63	198.52	11.94	107.47	6.46
2 31/32 x4 x2 31/32 x 7/16	18.90	220.75	11.68	115.64	6.12
3 1/32 x4 1/16 x3 1/32 x½	21.74	250.90	11.54	138.45	6.37
3 3/32 x4⅛ x3 3/32 x 9/16	24.58	280.48	11.41	163.10	6.64
3 1/16 x4 x3 1/16 x⅝	26.50	295.54	11.15	166.92	6.30
3 1/32 x4 1/16 x3 1/32 x 11/16	29.37	323.83	11.03	192.73	6.56
3 3/16 x4⅛ x3 3/16 x¾	32.25	351.60	10.90	220.72	6.84
6½″ Web Plate. 6¾″ Face to Face.					
2⅝ x3 x2⅝ x¼	9.39	98.12	10.45	31.74	3.38
2 1/16 x3 1/16 x2 1/16 x 5/16	11.79	121.99	10.35	42.15	3.58
2⅜ x3⅛ x2⅜ x⅜	14.20	144.98	10.21	53.41	3.76
2 7/32 x3 x2 7/32 x 7/16	15.96	157.65	9.88	55.62	3.49
2 13/32 x3 1/16 x2 13/32 x½	18.25	178.09	9.76	67.21	3.68

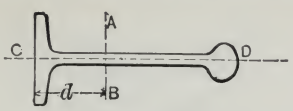
Size of Z Bar in Inches.	Area of 4 Z Bars and 1 Plate	Axis XX. I.	Axis XX. R^2.	Axis YY. I.	Axis YY. R^2.
8½″ Web Plate. 8¾″ Face to Face.					
3½ x6 x3½ x⅜	21.55	377.65	17.52	287.92	13.36
3 9/16 x6 1/16 x3 9/16 x 7/16	25.28	438.55	17.35	346.96	13.73
3⅜ x6⅛ x3⅜ x½	29.01	498.35	17.18	409.29	14.11
3½ x6 x3½ x 9/16	31.50	527.03	16.73	426.33	13.53
3 9/16 x6 1/16 x3 9/16 x⅝	35.15	582.27	16.65	489.35	13.92
3⅝ x6⅛ x3⅜ x 11/16	38.84	636.74	16.39	555.83	14.31
3½ x6 x3½ x¼	40.94	653.06	15.95	562.46	13.74
3 9/16 x6 1/16 x3 9/16 x 13/16	44.43	701.62	15.79	628.38	14.14
3⅝ x6⅛ x3⅜ x 7/8	48.08	751.66	15.63	699.15	14.54
8″ Web Plate. 8¼″ Face to Face.					
3 3/16 x5 x3 3/16 x 5/16	15.94	248.29	15.58	147.39	9.25
3¼ x5 1/16 x3¼ x⅜	19.20	296.02	15.42	183.48	9.56
3 5/16 x5⅛ x3 5/16 x 7/16	22.50	343.21	15.25	223.01	9.91
3 7/32 x5 x3 7/32 x½	24.92	370.53	14.87	234.40	9.41
3 9/32 x5 1/16 x3 9/32 x 9/16	28.14	414.08	14.72	273.74	9.73
3 11/32 x5⅛ x3 11/32 x⅝	31.40	457.31	14.56	315.58	10.05
3½ x5 x3½ x 13/16	33.34	472.79	14.18	320.12	9.60
3 5/16 x5 1/16 x3 5/16 x¼	36.56	513.78	14.05	362.98	9.93
7½″ Web Plate. 7¾″ Face to Face.					
2 7/32 x4 x2 7/32 x¼	11.16	153.17	13.72	65.72	5.89
2 15/32 x4 1/16 x2 15/32 x 15/16	13.98	189.95	13.59	85.86	6.14
3 x4⅛ x3 x⅜	16.81	225.94	13.44	107.47	6.39
2 31/32 x4 x2 31/32 x 7/16	19.12	251.40	13.15	115.64	6.05
3 1/32 x4 1/16 x3 1/32 x½	21.99	286.10	13.01	138.46	6.30
3 3/32 x4⅛ x3 3/32 x 9/16	24.86	319.96	12.87	163.11	6.56
3 1/16 x4 x3 1/16 x⅝	26.81	337.59	12.59	166.93	6.23
3 1/32 x4 1/16 x3 1/32 x 11/16	29.72	370.17	12.45	192.74	6.49
3 3/16 x4⅛ x3 3/16 x¾	32.63	402.09	12.32	220.73	6.77
7″ Web Plate. 7¼″ Face to Face.					
2⅝ x3 x2⅝ x¼	9.51	112.65	11.85	31.74	3.34
2 1/16 x3 1/16 x2 1/16 x 5/16	11.95	140.07	11.71	42.15	3.53
2⅜ x3⅛ x2⅜ x⅜	14.39	166.60	11.58	53.41	3.71
2 7/32 x3 x2 7/32 x 7/16	16.18	181.67	11.23	55.62	3.44
2 13/32 x3 1/16 x2 13/32 x½	18.50	205.32	11.10	67.21	3.63

ELEMENTS OF PENCOYD DECK BEAMS.



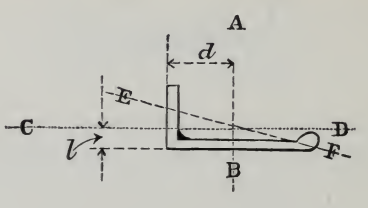
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.
Section Number.	*Size in Inches.*	*Area in Square Inches.*	*Weight in Pounds per Foot.*		*Moments of Inertia.*		*Square of Radius of Gyration.*		*Radius of Gyration.*	
			Iron.	*Steel.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*
69	$11\frac{1}{2}$	10.54	35.14	35.84	192.01	7.84	18.36	0.75	4.28	0.87
69	$11\frac{1}{2}$	13.41	44.70	45.59	223.63	8.06	16.78	0.60	4.10	0.78
62	10	8.27	27.56	28.12	120.75	6.31	14.74	0.77	3.84	0.88
62	10	11.39	37.96	38.73	146.75	7.69	12.98	0.68	3.60	0.82
63	9	7.26	24.20	24.68	84.77	4.92	11.82	0.69	3.44	0.83
63	9	9.51	31.70	32.33	99.95	5.69	10.60	0.60	3.26	0.78
64	8	6.17	20.56	20.98	57.66	3.63	9.44	0.59	3.07	0.77
64	8	8.42	28.06	28.63	69.66	4.41	8.33	0.53	2.89	0.73
65	7	5.26	17.53	17.88	37.05	2.59	7.11	0.50	2.67	0.71
65	7	7.22	24.06	24.55	45.46	3.23	6.34	0.45	2.52	0.67
66	6	4.22	14.06	14.35	21.95	1.64	5.25	0.39	2.29	0.63
66	6	5.72	19.06	19.45	26.61	2.04	4.69	0.36	2.16	0.60
67	5	3.39	11.30	11.53	12.04	0.98	3.57	0.29	1.89	0.54
67	5	4.64	15.46	15.78	14.64	1.268	3.17	0.27	1.78	0.52

ELEMENTS OF PENCOYD DECK BEAMS.



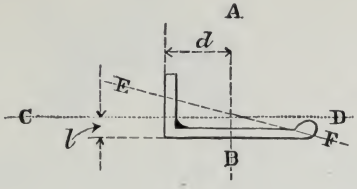
XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	II.
Resistance.	*Add to Previous Coeff. for each Additional Pound per Foot.*	*Coefficient in Net Tons for Greatest Safe Load Distributed.*		*Add to Previous Coeff. for each Additional Pound per Foot.*	*Coefficient for Deflection.*		*Maximum Load in Net Tons.*		*Distance "d" from Base to Neutral Axis.*	*Size in Inches.*
Axis A. B.		*Iron.*	*Steel.*		*Distributed.*	*Centre.*	*Iron.*	*Steel.*		
30.47	0.57	155.83	187.10	2.66	.0000082	.0000134	29.75	35.06	5.20	11½
37.90	0.57	181.50	217.80	2.66	.0000071	.0000115	52.19	61.51	5.60	11½
21.11	0.50	112.70	135.24	2.33	.0000130	.0000213	17.81	20.99	4.28	10
26.59	0.50	136.96	164.35	2.33	.0000107	.0000175	42.18	49.71	4.48	10
16.95	0.45	87.91	105.49	2.10	.0000185	.0000303	17.07	20.12	4.00	9
20.36	0.45	103.65	124.38	2.10	.0000157	.0000257	34.59	40.77	4.09	9
12.81	0.40	67.27	80.72	1.87	.0000272	.0000445	14.14	16.66	3.50	8
16.09	0.40	81.27	97.52	1.87	.0000225	.0000369	31.55	37.18	3.68	8
9.50	0.35	49.39	59.27	1.63	.0000423	.0000694	13.16	15.51	3.09	7
11.73	0.35	60.61	72.73	1.63	.0000345	.0000565	28.304	33.36	3.21	7
6.55	0.30	34.14	40.97	1.40	.0000712	.0000117	10.54	12.42	2.65	6
8.19	0.30	41.39	49.67	1.40	.0000589	.0000966	21.96	25.88	2.75	6
4.33	0.25	22.47	26.96	1.67	.0001302	.0002135	9.34	11.01	2.22	5
5.42	0.25	27.33	32.80	1.67	.0001071	.0001756	18.68	22.02	2.30	5

ELEMENTS OF PENCOYD BULB ANGLES.



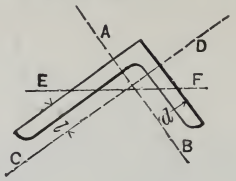
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
Section Number.	*Size in Inches.*	*Area in Sq. Inches.*	*Weight in Pounds per Foot.*		*Moments of Inertia.*			*Square of Radius of Gyration.*			*Radius of Gyration.*		
			Iron.	*Steel.*	*Axis A. B.*	*Axis C. D.*	*Axis E. F.*	*Axis A. B.*	*Axis C. D.*	*Axis E. F.*	*Axis A. B.*	*Axis C. D.*	*Axis E. F.*
255	5	2.81	9.36	9.55	12.43	2.13	1.68	4.42	0.76	0.56	2.10	0.87	0.75
255	5	3.43	11.43	11.66	18.70	3.25	1.96	5.45	0.95	0.58	2.33	0.97	0.76
254	6	3.72	12.40	12.65	22.59	4.10	2.08	6.07	1.12	0.56	2.46	1.06	0.75
254	6	4.95	16.50	16.83	33.76	4.56	3.33	6.82	0.92	0.67	2.61	0.96	0.82
253	7	4.69	15.64	15.95	29.50	2.66	2.96	6.29	0.57	0.63	2.50	0.76	0.79
253	7	5.95	19.85	20.24	36.31	3.36	3.66	6.10	0.56	0.62	2.47	0.74	0.78
252	8	5.72	19.09	19.47	48.30	3.80	3.75	8.44	0.66	0.65	2.90	0.82	0.80
252	8	7.14	23.82	24.30	59.20	5.26	5.16	8.29	0.73	0.72	2.88	0.83	0.84
251	9	6.60	22.00	22.44	63.96	4.67	4.90	9.71	0.71	0.86	3.11	0.84	0.92
251	9	7.72	25.73	26.24	75.80	5.74	6.24	9.82	0.74	0.86	3.13	0.80	0.89
250	10	7.53	25.09	25.59	85.15	5.37	5.46	11.31	0.71	0.73	3.36	0.84	0.85
250	10	9.22	30.74	21.35	96.99	6.44	6.80	10.41	0.69	0.72	3.22	0.83	0.84

ELEMENTS OF PENCOYD BULB ANGLES.



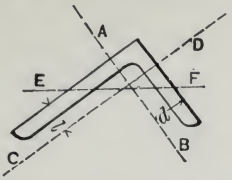
XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.	XXII.	XXIII.	XXIV.	XXV.	II.
Resistance.	*Add to Resistance for Each Additional Pound per Foot.*	*Coefficient in Net Tons for Greatest Safe Load Distributed.*		*Add to Previous Coeff. for Each Additional Pound per Foot.*	*Coefficient for Deflection.*		*Maximum Load in Net Tons.*		*Distance "d" from Base to Neutral Axis.*	*Distance "l" from Base to Neutral Axis.*	*Size in Inches.*
Axis A. B.		*Iron.*	*Steel.*		*Distributed.*	*Centre.*	*Iron.*	*Steel.*			
4.57	0.25	34.80	41.02	1.166	.0001260	.0002068	9.34	11.01	2.26	0.72	5
7.12	0.25	51.09	60.22	1.166	.0000838	.0001374	15.29	18.02	2.50	0.63	5
6.45	0.30	52.71	62.12	1.40	.0000694	.0001138	12.73	15.00	2.500	0.65	6
10.54	0.30	76.19	89.09	1.40	.0000464	.0000767	22.59	26.62	3.00	0.86	6
7.54	0.35	52.82	62.23	1.633	.0000531	.0000871	16.61	19.62	3.07	0.66	7
12.39	0.35	86.73	102.24	1.633	.0000431	.0000707	15.12	28.13	3.07	0.68	7
10.78	0.40	75.46	88.94	1.87	.0000324	.0000532	21.01	24.76	3.52	0.68	8
13.30	0.40	98.37	111.85	1.87	.0000265	.0000434	29.48	33.26	3.55	0.70	8
12.56	0.45	88.10	91.58	2.10	.0000245	.0000402	24.78	29.20	3.91	0.69	9
15.28	0.45	104.01	122.82	2.10	.0000206	.0000339	33.49	39.47	4.04	0.89	9
15.56	0.50	108.79	110.15	2.33	.0000184	.0000301	27.63	32.56	4.53	0.70	10
18.00	0.50	121.70	124.06	2.33	.0000155	.0000208	36.13	41.06	4.55	0.71	10

ELEMENTS OF PENCOYD ANGLES.



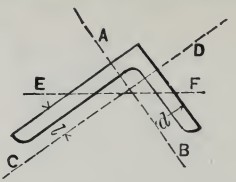
I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Section Number.	Size in Inches.	Thickness.	Area.	Weight per Foot.		Moments of Inertia.		
				Iron.	Steel.	Axis A. B.	Axis C. D.	Axis E. F.
120	6 x 6	3/8	4.36	14.53	14.82	15.38		6.19
120	6.25 x 6.25	1	11.55	38.50	39.27	41.73		17.33
121	5 x 5	3/8	3.60	12.00	12.24	8.74		3.53
121	5.5 x 5.5	1	9.83	32.76	33.42	25.79		10.85
122	4 x 4	5/16	2.40	8.00	8.16	3.71		1.50
122	4.3 x 4.3	3/4	5.69	18.96	19.34	10.25		4.28
123	3 1/2 x 3 1/2	5/16	2.09	6.96	7.11	2.44		0.99
123	3.75 x 3.75	5/8	4.19	13.96	14.24	5.41		2.25
124	3 x 3	1/4	1.45	4.83	4.93	1.24		0.50
124	3.3 x 3.3	5/8	3.43	11.43	11.64	3.41		1.44
125	2 3/4 x 2 3/4	1/4	1.31	4.36	4.45	0.95		0.38
125	2.91 x 2.91	1/2	2.63	8.76	8.94	1.93		0.81
126	2 1/2 x 2 1/2	3/16	0.90	3.00	3.06	0.55		0.22
126	2.70 x 2.70	1/2	2.40	8.00	8.16	1.67		0.70
127	2 1/4 x 2 1/4	3/16	0.79	2.63	2.68	0.39		0.16
127	2.29 x 2.29	3/8	1.59	5.30	5.41	0.76		0.32
128	2 x 2	3/16	0.72	2.40	2.45	0.27		0.11
128	2.12 x 2.12	3/8	1.45	4.83	4.93	0.58		0.24
129	1 3/4 x 1 3/4	3/16	0.63	2.10	2.14	0.18		0.07
129	1.87 x 1.87	3/8	1.29	4.30	4.39	0.41		0.17
130	1 1/2 x 1 1/2	1/8	0.34	1.13	1.16	0.07		0.03
130	1.62 x 1.62	3/8	1.05	3.50	3.57	0.23		0.10
131	1 1/4 x 1 1/4	1/8	0.30	1.00	1.02	0.04		0.02
131	1.33 x 1.33	1/4	0.59	1.97	2.01	0.09		0.04
132	1 x 1	1/8	0.23	0.77	0.78	0.02		0.01
132	1.08 x 1.08	1/4	0.45	1.50	1.53	0.05		0.02
154	7 x 3 1/2	1/2	5.00	16.67	17.00	29.28	4.41	3.57
154	7.03 x 3.53	1	9.56	31.87	32.50	49.00	9.30	6.94
152	6 1/2 x 4	3/8	3.78	12.60	12.85	16.78	5.01	3.35
152	7.0 x 4.5	1	10.08	33.60	34.27	46.04	15.52	11.02
140	6 x 4	3/8	3.60	12.00	12.24	13.47	4.90	3.05
140	6.5 x 4.5	1	9.80	32.67	33.32	43.07	17.05	11.26

ELEMENTS OF PENCOYD ANGLES.



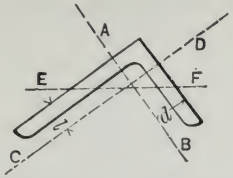
X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	I.
Radii of Gyration.			*Resistance.*		*Distance from Base to Neutral Axis.*		*Section Number.*
Axis A. B.	*Axis C. D.*	*Axis E. F.*	*Axis A. B.*	*Axis C. D.*	*d.*	*l.*	
1.88		1.19	3.53		1.64		120
1.90		1.22	9.64		1.92		120
1.56		0.99	2.42		1.39		121
1.61		1.05	6.94		1.72		121
1.14		0.79	1.29		1.12		122
1.34		0.86	3.50		1.37		122
1.08		0.69	1.97		0.99		123
1.14		0.73	2.09		1.16		123
0.92		0.59	0.57		0.84		124
0.99		0.64	1.51		1.04		124
0.85		0.53	0.48		0.78		125
0.86		0.55	0.96		0.90		125
0.78		0.49	0.31		0.70		126
0.83		0.54	0.91		0.87		126
0.69		0.44	0.24		0.63		127
0.69		0.49	0.48		0.72		127
0.62		0.39	0.19		0.57		128
0.63		0.41	0.40		0.67		128
0.54		0.33	0.15		0.51		129
0.56		0.36	1.33		0.61		129
0.45		0.29	0.06		0.42		130
0.47		0.31	0.21		0.54		130
0.37		0.26	0.04		0.35		131
0.39		0.26	1.00		0.42		131
0.29		0.21	0.03		0.30		132
0.33		0.21	0.07		0.37		132
2.42	0.90	0.84	6.54	1.61	2.53	0.76	154
2.02	0.99	0.85	11.34	3.70	2.71	1.02	154
2.11	1.15	0.93	3.85	1.94	2.15	0.90	152
2.14	1.12	1.02	10.08	4.76	2.43	1.25	152
1.93	1.17	0.90	3.32	1.60	1.94	0.94	140
2.05	1.32	1.07	10.30	5.36	2.32	1.32	140

ELEMENTS OF PENCOYD ANGLES.



I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Section Number.	Size in Inches.	Thickness.	Area.	Weight per Foot.		Moments of Inertia.		
				Iron.	Steel.	Axis A. B.	Axis C. D.	Axis E. F.
151	6 x 3½	⅜	3.39	11.30	11.53	12.85	3.34	2.30
151	6.45 x 3.95	1	9.39	31.30	31.93	37.60	10.97	7.78
153	5½ x 3½	⅜	3.23	10.76	10.98	10.12	3.27	2.10
153	5.70 x 3.7	⅝	5.35	17.83	18.19	16.97	5.54	3.67
141	5 x 4	⅜	3.23	10.76	10.98	8.13	4.66	2.44
141	5.30 x 4.30	¾	6.41	21.36	21.79	17.47	10.21	5.54
142	5 x 3½	5/16	2.56	8.53	8.70	6.60	2.72	1.61
142	5.30 x 3.80	¾	5.92	19.73	20.12	17.06	7.27	4.31
143	5 x 3	5/16	2.40	8.00	8.16	6.26	1.75	1.19
143	5.30 x 3.30	¾	5.55	18.50	18.87	14.46	4.06	3.27
144	4½ x 3	5/16	2.27	7.56	7.72	4.68	1.70	1.10
144	4.85 x 3.35	¾	5.28	17.60	17.95	11.77	4.39	3.10
145	4 x 3½	5/16	2.27	7.56	7.71	3.56	2.55	1.22
145	4.35 x 3.85	¾	5.28	17.60	17.95	7.76	5.63	3.40
146	4 x 3	5/16	2.09	6.96	7.11	3.38	1.65	0.93
146	4.25 x 3.25	⅝	4.19	13.96	14.24	7.20	3.59	2.14
147	3½ x 3	5/16	1.93	6.43	6.56	2.33	1.58	0.62
147	3.75 x 3.25	⅝	3.86	12.86	13.12	3.66	3.15	1.81
150	3½ x 2½	¼	1.45	4.83	4.93	1.80	0.78	0.47
150	3.65 x 2.65	½	2.77	9.23	9.41	3.64	1.60	0.99
148	3 x 2½	¼	1.31	4.36	4.45	1.17	0.74	0.37
148	3.20 x 2.70	½	2.63	8.76	8.94	2.38	1.53	0.87
149	3 x 2	¼	1.20	4.00	4.08	1.09	0.39	0.25
149	3.2 x 2.20	½	2.40	8.00	8.16	2.52	0.98	0.60
155	2½ x 2	3/16	0.79	2.63	2.68	0.51	0.29	0.15
155	2.66 x 2.16	½	2.12	7.06	7.20	1.40	0.85	0.46
156	2¼ x 1½	3/16	0.67	2.23	2.27	0.34	0.12	0.08
156	2.37 x 1.62	⅜	1.34	4.46	4.56	0.70	0.26	0.18
157	2 x 1¼	3/16	0.57	1.91	1.95	0.23	0.07	0.05
157	2.12 x 1.37	⅜	1.17	3.90	3.98	0.50	0.16	0.12
159	3½ x 2	23/100	1.21	4.04	4.12	1.56	0.38	0.27
159	3.6 x 2.1	⅜	1.93	6.42	6.55	2.60	0.57	0.83

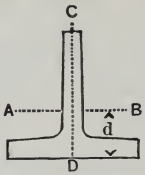
ELEMENTS OF PENCOYD ANGLES.



X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	I.
Radii of Gyration.			*Resistance.*		*Distance from Base to Neutral Axis.*		*Section Number.*
Axis A. B.	*Axis C. D.*	*Axis E. F.*	*Axis A. B.*	*Axis C. D.*	*d.*	*l.*	
1.94	0.99	0.84	3.24	1.23	2.05	0.79	151
2.00	1.08	0.90	9.01	3.90	2.35	1.14	151
1.77	1.01	0.81	2.75	1.22	1.82	0.82	153
1.78	1.01	0.83	4.48	2.00	1.94	0.94	153
1.59	1.20	0.87	2.35	1.57	1.53	1.03	141
1.65	1.26	0.92	4.86	3.32	1.73	1.23	141
1.61	1.03	0.79	1.93	1.03	1.61	0.86	142
1.69	1.10	0.85	4.90	2.66	1.82	1.07	142
1.61	0.85	0.70	1.88	0.75	1.70	0.68	143
1.61	0.86	0.76	4.21	1.67	1.87	0.87	143
1.43	0.86	0.69	1.51	0.75	1.46	0.72	144
1.48	0.89	0.76	3.72	1.82	1.69	0.94	144
1.25	1.05	0.73	1.26	0.99	1.18	0.93	145
1.21	1.03	0.79	2.59	2.05	1.36	1.11	145
1.27	0.89	0.67	1.23	0.74	1.26	0.76	146
1.30	0.92	0.70	2.54	1.54	1.42	0.92	146
1.10	0.90	0.57	0.95	0.72	1.06	0.81	147
0.96	0.90	0.67	1.37	1.21	1.09	0.99	147
1.11	0.73	0.57	0.75	0.41	1.11	0.61	150
1.14	0.76	0.59	1.50	0.84	1.23	0.73	150
0.95	0.75	0.53	0.56	0.40	0.92	0.66	148
0.95	0.76	0.57	1.34	0.83	1.03	0.78	148
0.95	0.56	0.46	0.54	0.25	0.99	0.49	149
1.02	0.64	0.49	1.22	0.62	1.14	0.64	149
0.80	0.60	0.44	0.29	0.19	0.76	0.51	155
0.81	0.62	0.46	0.80	0.57	0.92	0.67	155
0.71	0.42	0.35	0.23	0.10	0.74	0.37	156
0.72	0.44	0.36	0.46	0.23	0.83	0.46	156
0.63	0.35	0.30	0.18	0.07	0.69	0.31	157
0.65	0.37	0.31	0.38	0.17	0.78	0.41	157
1.13	0.56	0.47	0.65	0.25	1.31	0.45	159
1.16	0.55	0.66	1.14	0.37	1.32	0.55	159

ELEMENTS OF PENCOYD TEES.

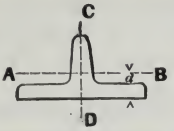
EVEN LEGS.



I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
Section Number.	*Size in Inches.*	*Area in Square Inches.*	*Weight in Pounds per Foot.*		*Moments of Inertia.*		*Resistance.*		*Radius of Gyration.*		*Distance "d" from Base to Neutral Axis.*
			Iron.	*Steel.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	
70	4 x 4 x $\frac{9}{16}$	3.72	12.40	12.65	5.56	2.70	1.97	1.35	1.23	0.85	1.19
71	$3\frac{1}{2}$ x $3\frac{1}{2}$ x $\frac{15}{32}$	3.05	10.17	10.37	3.47	1.70	1.38	0.97	1.06	0.74	1.00
72	3 x 3 x $\frac{13}{32}$	2.50	8.33	8.50	2.10	1.01	1.00	0.67	0.90	0.62	0.90
73	$2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{7}{16}$	1.95	6.50	6.63	1.12	0.58	0.64	0.46	0.78	0.55	0.75
74	$2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{3}{8}$	1.72	5.73	5.84	0.97	0.49	0.55	0.39	0.75	0.53	0.75
75	$2\frac{1}{4}$ x $2\frac{1}{4}$ x $\frac{1}{4}$	1.17	3.90	3.98	0.52	0.30	0.31	0.26	0.65	0.50	0.61
76	$2\frac{1}{4}$ x $2\frac{1}{4}$ x $\frac{9}{32}$	1.18	3.93	4.01	0.54	0.27	0.34	0.24	0.67	0.47	0.65
77	2 x 2 x $\frac{9}{32}$	1.04	3.47	3.54	0.38	0.19	0.27	0.19	0.60	0.43	0.60
78	$1\frac{3}{4}$ x $1\frac{3}{4}$ x $\frac{7}{32}$	0.71	2.37	2.41	0.21	0.10	0.16	0.11	0.54	0.37	0.50
79	$1\frac{1}{2}$ x $1\frac{1}{2}$ x $\frac{7}{32}$	0.60	2.00	2.04	0.13	0.06	0.12	0.08	0.46	0.32	0.45
80	$1\frac{1}{4}$ x $1\frac{1}{4}$ x $\frac{3}{16}$	0.45	1.50	1.53	0.07	0.04	0.08	0.06	0.37	0.27	0.37
81	1 x 1 x $\frac{3}{16}$	0.31	1.03	1.05	0.03	0.02	0.04	0.04	0.30	0.26	0.30
82	3 x 3 x $\frac{11}{32}$	1.93	6.43	6.56	1.59	0.75	0.73	0.50	0.91	0.62	0.84
83	3 x 3 x $\frac{13}{32}$	2.26	7.53	7.68	1.83	0.89	0.85	0.59	0.90	0.63	0.86
84	$2\frac{1}{2}$ x $2\frac{1}{2}$ x $\frac{11}{32}$	1.45	4.83	4.93	0.79	0.38	0.44	0.30	0.74	0.51	0.71
85	4 x 4 x $\frac{1}{2}$	3.29	10.98	11.19	5.1	2.5	1.79	1.25	1.20	0.83	1.15

ELEMENTS OF PENCOYD TEES.

UNEVEN LEGS.

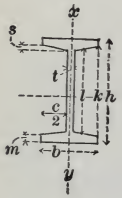


I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
Section Number.	*Size in Inches.*	*Area in Square Inches.*	*Weight in Pounds per Foot.*		*Moments of Inertia.*		*Resistance.*		*Radius of Gyration.*		*Distance "d" from Base to Neutral Axis.*
			Iron.	*Steel.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	*Axis A. B.*	*Axis C. D.*	
90	4½ x 3½	4.45	14.83	15.13	5.27	3.66	2.25	1.62	1.09	0.91	1.16
91	4 x 3½	4.18	13.93	14.21	4.65	3.23	1.93	1.62	1.05	0.88	1.09
92	5 x 2½	3.07	10.23	10.44	1.61	4.01	0.88	1.60	0.72	1.14	0.67
93	5 x 2½	3.31	11.03	11.25	1.63	4.58	0.88	1.83	0.70	1.17	0.64
94	4 x 3	2.59	8.63	8.81	1.94	2.18	0.87	1.09	0.86	0.92	0.77
95	4 x 3	2.51	8.37	8.53	2.09	1.69	0.97	0.85	0.91	0.82	0.84
96	4 x 2	1.93	6.43	6.56	0.55	1.84	0.36	0.92	0.53	0.98	0.47
97	3 x 3½	2.81	9.37	9.55	3.12	1.06	1.30	0.70	1.05	0.61	1.10
98	3 x 2½	2.38	7.93	8.09	1.38	0.94	0.82	0.62	0.76	0.63	0.82
99	3 x 1½	1.12	3.73	3.81	0.19	0.56	0.17	0.37	0.41	0.71	0.37
100	2½ x 1½	0.91	3.03	3.09	0.10	0.33	0.10	0.26	0.43	0.50	0.32
101	2 x 1½	0.87	2.90	2.96	0.16	0.18	0.15	0.18	0.33	0.45	0.43
102	2 x 1	0.70	2.33	2.38	0.05	0.17	0.07	0.17	0.26	0.49	0.27
103	2 x $\frac{9}{16}$	0.61	2.03	2.07	0.01	0.17	0.02	0.17	0.13	0.54	0.17
104	2¾ x 1¾	1.96	6.53	6.66	0.56	0.62	0.50	0.45	0.53	0.51	0.64
105	2¾ x 2	2.14	7.13	7.28	0.83	0.63	0.66	0.45	0.63	0.55	0.75
106	5 x 3½	4.84	16.13	16.46	5.37	5.31	2.19	2.12	1.05	1.01	1.05
107	5 x 4	4.41	14.70	14.99	6.24	5.25	2.13	2.10	1.19	1.09	1.08
108	2¼ x $\frac{9}{16}$	0.66	2.20	2.24	0.01	0.24	0.02	0.21	0.12	0.61	0.18
109	4 x 4½	3.97	13.23	13.50	7.77	2.71	2.49	1.36	1.40	0.82	1.39
110	3 x 2½	1.76	5.87	5.98	0.94	0.74	0.52	0.49	0.73	0.05	0.69
111	3 x 2½	2.06	6.87	7.00	1.08	0.89	0.60	0.59	0.72	0.66	0.70
112	2 x 1 $\frac{1}{16}$	0.62	2.07	2.11	0.04	0.17	0.05	0.17	0.23	0.17	0.23
113	1¾ x 1 $\frac{1}{16}$	0.56	1.87	1.90	0.04	0.11	0.05	0.12	0.27	0.44	0.24
114	1½ x $\frac{13}{16}$	0.41	1.37	1.39	0.02	0.06	0.02	0.08	0.22	0.38	0.17
115	1¼ x $\frac{13}{16}$	0.34	1.13	1.16	0.02	0.03	0.03	0.05	0.24	0.30	0.24
116	1¾ x 1¼	1.04	3.47	3.54	0.12	0.05	0.14	0.06	0.34	0.22	0.42
117	3 x 2½	1.50	5.00	5.10	0.79	0.60	0.42	0.40	0.73	0.63	0.65
118	3 x 2½ x $\frac{3}{8}$	1.77	5.92	6.03	1.6	0.44	1.01	0.30	0.94	0.51	0.92
119	2¾ x 2½ x $\frac{3}{8}$	1.69	5.63	5.74	1.2	0.44	0.72	0.32	0.83	0.51	0.83

MOMENTS OF INERTIA OF STANDARD SECTIONS.

When not otherwise specified, the inertia is the greatest around centre of gravity, or for horizontal axis in figures.

A = total area of section.



I Beam Section.

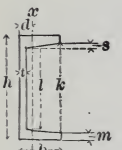
s = taper of flange.

$$l = k - \frac{2s}{3}.$$

$$I = \frac{bh^3 - ck^3}{12} + \frac{cs^3}{18} + \frac{csl^2}{4}.$$

$$I, \text{ axis } xy = \frac{mb^3}{6} + \frac{kt^3}{12} + \frac{s\left(\frac{b-t}{2}\right)^3}{9} + 2s\left(\frac{b-t}{2}\right)\left(\frac{b}{6} + \frac{t}{3}\right)^2.$$

Channel Section.



s = taper of flange.

$$r = \frac{s}{b-t}.$$

$$I = \frac{bh^3 - \frac{1}{8r}\left(k^4 - l^4\right)}{12}.$$

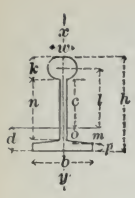
$$I, \text{ axis } xy = \frac{2mb^3 + lt^3 + \frac{r}{2}\left(b^4 - t^4\right)}{3} - Ad^2.$$

$$d = \frac{mb^2 + \frac{kt^2}{2} + \frac{s}{3}\left(b-t\right)\left(b+2t\right)}{A}.$$

Deck Beam Section.

s = taper of flange. $\quad a$ = area of bulb.

$$o = m - \frac{s}{3}.$$

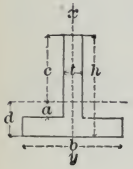


$$I = \frac{aw^2}{15} + al^2 + \frac{tc^3}{3} + \frac{bd^3}{3} - \frac{m^3(b-t)}{3} + \frac{(b-t)s^3}{36} + \frac{s(b-t)o^2}{2}.$$

$$I, \text{ axis } xy = \frac{ak^2}{12.4} + \frac{nt^3}{12} + \frac{\left(p + \frac{s}{4}\right)b^3}{12}$$

$$d = \frac{a(2h-k) + t(h-k)^2 + (b-t)p^2 + s(b-t)\left(p + \frac{s}{3}\right)}{2.A}.$$

TEE SECTION.

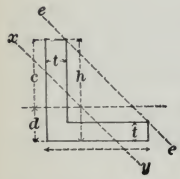


$$I = \frac{tc^3 + bd^3 - (b-t)a^3}{3}.$$

$$I, \text{ axis } xy = \frac{fb^3 + (h-f)t^3}{12}.$$

$$d = \frac{bf^2 + t(h^2 - f^2)}{2.A}.$$

ANGLE SECTION.



$$I = \frac{tc^3 + bd^3 - (b-t)(d-t)^3}{3}.$$ For even or uneven angles.

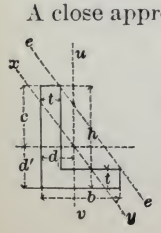
$$I, \text{ axis } uv = \frac{t(b-d_1)^3 + hd_1^3 - (h-t)(d_1-t)^3}{3}.$$ For uneven angles.

---

xy passes through centre of gravity parallel to ee.

$$I \text{ axis } xy = \frac{2d^4 - 2(d-t)^4 + t\left[b - \left(2d - \frac{t}{2}\right)\right]^3}{3}.$$ For even angles.

A close approximation for the latter is the following:



$$I, \text{ axis } xy = \frac{Ah^2}{25}.$$ For even angles.

$$I, \text{ axis } xy = \frac{Ah^2b^2}{13(h^2+b^2)}.$$ For uneven angles.

$$d = \frac{bt^2 + t(h^2 - t^2)}{2.A}.$$ For even and uneven angles.

$$d' = \frac{ht^2 + t(b^2 - t^2)}{2A}.$$ For uneven angles.

In uneven angles the distance from centre of gravity in direction of the long leg exceeds that in the direction of the short leg by half the difference in the length of the two legs.

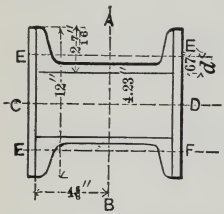
In angles and tees of equal legs and thickness

$$d = \tfrac{1}{4}\left(b + \frac{3}{2}t\right) \text{ nearly.}$$

Inertia of Compound Shapes.

"The moment of inertia of any section about any axis is equal to the I about a parallel axis passing through its centre of gravity + the area of the section multiplied by the square of the distance between the axes."

By use of this rule, the moments of inertia or radii of gyration of any single sections being known, corresponding values can readily be obtained for any combination of these sections.



Example No. 1.—A combination of two 9″ channels of 5.17 square inches section, and two 12 × ¼ plates as shown.

Axis A B of Section.

I for two channels, col. VI, page 154, = 122.360

I for two plates $= \frac{12 \times .25^3}{12} \times 2 = .03125$

6 (area of plates) $\times 4\frac{5}{8}^2$ = 128.34375 = 128.375

I for combined section = 250.735

which divided by area (16.34) gives $15.3448 = R^2$ or 3.917 radius of combined section.

Axis C D.

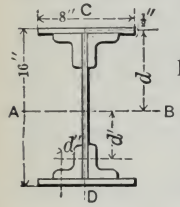
Find distance $d = (.67)$ from col. XII, page 154, then obtaining the distance (4.0763) between axes $C\,D$ and EF.

I for two channels around axis EF from col. VII, $= 5.50$
Area of channels $\times$ sq. of dist. $= 10.34 \times 4.0763^2 = 171.8115$
I for two plates $= \dfrac{.5 \times 12^3}{12} = 72.$

I for combined section $= 249.3115$

Radius of gyration $= \sqrt{\dfrac{249.3115}{16.34}} = 3.906.$

By similar methods, inertia or radius of gyration for any combination of shapes can readily be obtained.



Example No. 2.—A "built-up beam" composed of: 4 angles $3'' \times 3'' \times \frac{1}{4}''$.
2 plates $8'' \times \frac{1}{2}''$.
1 plate $15'' \times \frac{3}{8}''$.

Axis A B.

I of two $8'' \times \frac{1}{2}$ plates $= \dfrac{8 \times \frac{1}{2}^3}{12} \times 2 = .167$
$+ 8$ (area) $\times 7\frac{3}{4}^2$ (sq. of distance d) $= 480.5$
480.667

I of one $15'' \times \frac{3}{8}''$ plate $= \dfrac{15^3 \times \frac{3}{8}}{12} = 105.469$

I of four $3 \times 3 \times \frac{1}{4}$ angles $= 4 \times 1.24$ (see col. VII, page 166, $= 4.96$
$+ 5.80$ (area) $\times 6.66^2$ (sq. of distance d^1) $= 257.262$
262.222

Inertia of combined section around $A\,B = 848.358$

Radius of gyration $= \sqrt{\dfrac{848.358}{19.425}} = 6.61.$

Radius of Gyration of Compound Shapes.

In the case of a pair of any shape without a web the value of R can always be readily found without considering the moment of inertia.

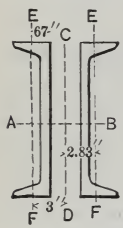
The radius of gyration for any section around an axis parallel to another axis passing through its centre of gravity is found as follows:

Let r = radius of gyration around axis through centre of gravity. R = radius of gyration around another axis parallel to above. d = distance between axis.

$$R = \sqrt{d^2 + r^2}.$$

When r is small, R may be taken as equal to d without material error. Thus, in the case of a pair of channels latticed together, or a similar construction.

Example No. 1.—Two 9″ channels of 5.17 square inches section placed 4.66″ apart, required the radius of gyration around axis CD for combined section.



Find r on col. XI, page 154,=.73 and r^2 = .5329.

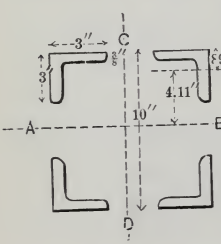
Find distance from base of channel to neutral axis, col. XII, same page, = .67, this added to one half the distance between the two bars, 2.33″ = 3″ = d, and d^2 = 9.

Radius of gyration of the pair as placed =

$$\sqrt{9 + .5329} = 3.087.$$

The value of R for the whole section in relation to the axis $A\,B$ is the same as for the single channel, to be found in the tables.

Example No. 2.—Four 3″ × 3″ × $\frac{3}{8}$″ angles placed as shown, form a column of 10 inches square; required the radius of gyration.



Find r on col. X, page 157,= .94, and r^2 = .8836.

Find distance from side of angle to neutral axis, col. XV, same page, = .91. Subtract this from half the width of column = 5. — .91 = 4.09 = d or distance between two axes. d^2 = 16.7281.

Radius of gyration of four angles as placed =

$$\sqrt{16.7281 + .8836} = 4.20.$$

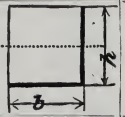
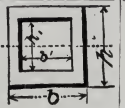
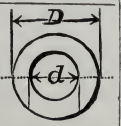
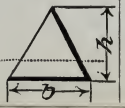
When the angles are large as compared with the outer dimensions of the combined section, the radius of gyration can be taken without serious error from the table of radii of gyration for square columns, on page 207.

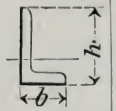
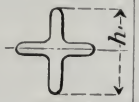
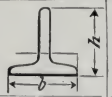
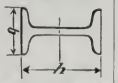
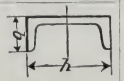
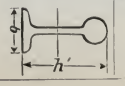
MOMENT OF INERTIA OF RECTANGLES.

Depth in Inches.	Width of Rectangle in Inches.						
	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$
6	4.50	5.63	6.75	7.88	9.00	10.13	11.25
7	7.15	8.93	10.72	12.51	14.29	16.08	17.86
8	10.67	13.33	16.00	18.67	21.33	24.00	26.67
9	15.19	18.98	22.78	26.58	30.38	34.17	37.97
10	20.83	26.04	31.25	36.46	41.67	46.87	52.08
11	27.73	34.66	41.59	48.53	55.46	62.39	69.32
12	36.00	45.00	54.00	63.00	72.00	81.00	90.00
13	45.77	57.21	68.66	80.10	91.54	102.98	114.43
14	57.17	71.46	85.75	100.04	114.33	128.63	142.92
15	70.31	87.89	105.47	123.05	140.63	158.20	175.78
16	85.33	106.67	128.00	149.33	170.67	192.00	213.33
17	102.35	127.94	153.53	179.12	204.71	230.30	255.89
18	121.50	151.88	182.25	212.63	243.00	273.38	303.75
19	142.90	178.62	214.34	250.07	285.79	321.52	357.24
20	166.67	208.33	250.00	291.67	333.33	375.00	416.67
21	192.94	241.17	289.41	337.64	385.88	434.11	482.34
22	221.83	277.29	332.75	388.21	443.67	499.13	554.58
23	253.48	316.85	380.22	443.59	506.96	570.33	633.70
24	288.00	360.00	432.00	504.00	576.00	648.00	720.00
25	325.52	406.90	488.28	569.66	651.04	732.42	813.80
26	366.17	457.71	549.25	640.79	732.33	823.88	915.42
27	410.06	512.58	615.09	717.61	820.13	922.64	1025.16
28	457.33	571.67	686.00	800.33	914.67	1029.00	1143.33
29	508.10	635.13	762.16	889.18	1016.21	1143.23	1270.26
30	562.50	703.13	843.75	984.38	1125.00	1265.63	1406.25
31	620.65	775.81	930.97	1086.13	1241.30	1396.46	1551.62
32	682.67	853.33	1024.00	1194.67	1365.33	1536.00	1706.67
33	748.69	935.86	1123.03	1310.20	1497.38	1584.55	1871.72
34	818.83	1023.54	1228.25	1432.96	1637.67	1842.38	2047.08
35	893.23	1116.54	1339.84	1563.15	1786.46	2009.76	2233.07
36	972.00	1215.00	1458.00	1701.00	1944.00	2187.00	2430.00
37	1055.27	1319.09	1582.90	1846.72	2110.54	2374.35	2638.17
38	1143.17	1428.96	1714.75	2000.54	2286.33	2572.13	2857.92
39	1235.81	1544.77	1853.72	2162.67	2471.62	2780.58	3089.53
40	1333.33	1666.67	2000.00	2333.33	2666.67	3000.00	3333.33

ELEMENTS OF USUAL SECTIONS.

Moments refer to horizontal axis through centre of gravity. This table is intended for convenient application where extreme accuracy is not important. Some of the terms are only approximate; those marked * are correct. Values for radius of gyration in flanged beams apply to standard minimum sections only. A = area of section.

Shape of Section.	*Moment of Inertia.*	*Moment of Resistance.*	*Distance of Base from Centre of Gravity.*	*Square of Least Radius of Gyration.*	*Least Radius of Gyration.*
Solid Rectangle. 	$\frac{bh^3}{12}$ *	$\frac{bh^2}{6}$ *	$\frac{h}{2}$	$\frac{(\text{Least side})^2}{12}$ *	$\frac{\text{Least side}}{3.46}$ *
Hollow Square. 	$\frac{bh^3-b_1h_1^3}{12}$ *	$\frac{bh^3-b_1h_1^3}{6h}$ *	$\frac{h}{2}$	$\frac{h^2+h_1^2}{12}$ *	$\frac{h+h_1}{4.89}$
Solid Circle.	$\frac{AD^2}{16}$ *	$\frac{AD}{8}$ *	$\frac{D}{2}$	$\frac{D^2}{16}$ *	$\frac{D}{4}$ *
Hollow Circle. A = area of large section. a = area of small section. 	$\frac{AD^2-ad^2}{16}$	$\frac{AD^2-ad^2}{8D}$	$\frac{D}{2}$	$\frac{D^2+d^2}{16}$ *	$\frac{D+d}{5.64}$
Solid Triangle. 	$\frac{bh^3}{36}$	$\frac{bh^2}{24}$	$\frac{h}{3}$	The least of the two: $\frac{h^2}{18}$ or $\frac{b^2}{24}$	The least of the two: $\frac{h}{4.24}$ or $\frac{b}{4.9}$

Even Angle.	$\frac{Ah^2}{10.2}$	$\frac{Ah}{7.2}$	$\frac{h}{3.3}$	$\frac{h^2}{25}$	$\frac{b}{5}$
Uneven Angle. 	$\frac{Ah^2}{9.5}$	$\frac{Ah}{6.5}$	$\frac{h}{3.5}$	$\frac{(hb)^2}{13\,(h^2+b^2)}$	$\frac{hb}{2.6\,(h+b)}$
Even Cross. 	$\frac{Ah^2}{19}$	$\frac{Ah}{9.5}$	$\frac{h}{2}$	$\frac{h^2}{22.5}$	$\frac{h}{4.74}$
Even Tee. 	$\frac{Ah^2}{11.1}$	$\frac{Ah}{8}$	$\frac{h}{3.3}$	$\frac{b^2}{22.5}$	$\frac{b}{4.74}$
I *Beam.* 	$\frac{Ah^2}{6.66}$	$\frac{Ah}{3.2}$	$\frac{h}{2}$	$\frac{b^2}{21}$	$\frac{b}{4.58}$
Channel. 	$\frac{Ah^2}{7.34}$	$\frac{Ah}{3.67}$	$\frac{h}{2}$	$\frac{b^2}{12.5}$	$\frac{b}{3.54}$
Deck Beam. 	$\frac{Ah^2}{6.9}$	$\frac{Ah}{4}$	$\frac{h}{2.3}$	$\frac{b^2}{36.5}$	$\frac{b}{6}$

STRUTS OF IRON AND STEEL.

In the following consideration of struts of various sections the least radius of gyration of the cross-section, around an axis through the centre of gravity, is assumed as the effective radius of the strut. The tables on pages 182 to 187 are the classified averages of an extensive series of experiments on iron and steel struts.

The tables for destructive pressures represent the ultimate load at the point of failure.

The greatest safe loads are the aforesaid crippling loads, divided by the factors of safety hereafter described.

As is well known, the method of securing the ends of the struts exercises an important influence on their resistance to bending, as the member is held more or less rigidly in the direct line of thrust.

In the general tables, struts are classified in four divisions, viz.: "Fixed Ended," "Flat Ended," "Hinged Ended," and "Round Ended."

In the class of "fixed ends" the struts are supposed to be so rigidly attached at both ends to the contiguous parts of the structure that the attachment would not be severed if the member was subjected to the ultimate load. "Flat-ended" struts are supposed to have their ends flat and normal to the axis of length, but not rigidly attached to the adjoining parts. "Hinged ends" embrace the class which have both ends properly fitted with pins, or ball and socket joints, of substantial dimensions as compared with the section of the strut; the centres of these end joints being practically coincident with an axis passing through the centre of gravity of the section of the strut. "Round-ended" struts are those which have only central points of contact, such as balls or pins resting on flat plates, but still the centres of the balls or pins coincident with the proper axis of the strut.

If in hinged-ended struts the balls or pins are of comparatively insignificant diameter, it will be safest in such cases to consider the struts as round-ended.

If there should be any serious deviation of the centres of

round or hinged ends from the proper axis of the strut, there will be a reduction of resistance that cannot be estimated without knowing the exact conditions.

When the pins of hinged-end struts are of substantial diameter, well fitted, and exactly centered, experiment shows that the hinged-ended will be equally as strong as flat-ended struts. But a very slight inaccuracy of the centering rapidly reduces the resistance to lateral bending, and as it is almost impossible in practice to uniformly maintain the rigid accuracy required, it is considered best to allow for such inaccuracies to the extent given in the tables, which are the average of many experiments.

It is considered good practice to increase the factors of safety as the length of the strut is increased, owing to the greater inability of the long struts to resist cross strains, etc. For similar reasons we consider it advisable to increase the factor of safety for hinged and round ends in a greater ratio than for fixed or flat ends.

Presuming that one-third of the ultimate load would constitute the greatest safe load for the shortest struts, the following progressive factors of safety are adopted for the increasing lengths.

$$3. + .01\ \frac{l}{r} \text{ for flat and fixed ends.}$$

$$3\ + .015\frac{l}{r} \text{ for hinged and round ends.}$$

l = length of strut. r = least radius of gyration.

From the above we derive the following factors of safety:

$\frac{l}{r}$	*Fixed and Flat Ends.*	*Hinged and Round Ends.*	$\frac{l}{r}$	*Fixed and Flat Ends.*	*Hinged and Round Ends.*	$\frac{l}{r}$	*Fixed and Flat Ends.*	*Hinged and Round Ends.*
20	3.2	3.3	110	4.1	4.65	200	5.0	6.0
30	3.3	3.45	120	4.2	4.8	210	5.1	6.15
40	3.4	3.6	130	4.3	4.95	220	5.2	6.3
50	3.5	3.75	140	4.4	5.1	230	5.3	6.45
60	3.6	3.9	150	4.5	5.25	240	5.4	6.6
70	3.7	4.05	160	4.6	5.4	250	5.5	6.75
80	3.8	4.2	170	4.7	5.55	260	5.6	6.9
90	3.9	4.35	180	4.8	5.7	270	5.7	7.05
100	4.0	4.5	190	4.9	5.85	280	5.8	7.2

WROUGHT IRON STRUTS.—No. 1.

Destructive pressure in pounds per square inch.

Length. / *Least Radius of Gyration.*	*Fixed Ends.*	*Flat Ends.*	*Hinged Ends.*	*Round Ends.*
20	46000	46000	46000	44000
30	43000	43000	43000	40250
40	40000	40000	40000	36500
50	38000	38000	38000	33500
60	36000	36000	36000	30500
70	34000	34000	33750	27750
80	32000	32000	31500	25000
90	31000	30900	29750	22750
100	30000	29800	28000	20500
110	29000	28050	26150	18500
120	28000	26300	24300	16500
130	26750	24900	22650	14650
140	25500	23500	21000	12800
150	24250	21750	18750	11150
160	23000	20000	16500	9500
170	21500	18400	14650	8500
180	20000	16800	12800	7500
190	18750	15650	11800	6750
200	17500	14500	10800	6000
210	16250	13600	9800	5500
220	15000	12700	8800	5000
230	14000	11950	8150	4650
240	13000	11200	7500	4300
250	12000	10500	7000	4050
260	11000	9800	6500	3800
270	10500	9150	6100	3500
280	10000	8500	5700	3200
290	9500	7850	5350	3000
300	9000	7200	5000	2800
310	8500	6600	4750	2650
320	8000	6000	4500	2500
330	7500	5550	4250	2300
340	7000	5100	4000	2100
350	6750	4700	3750	2000
360	6500	4300	3500	1900
370	6150	3900	3250	1800
380	5800	3500	3000	1700
390	5500	3250	2750	1600
400	5200	3000	2500	1500

IRON STRUTS.—No. 2.

Greatest safe load in pounds per square inch of cross-section for vertical struts. Both ends are supposed to be secured as indicated at the head of each column.

If both ends are not secured alike, take a mean proportional between the values given for the classes to which each end belongs.

If the strut is hinged by any uncertain method, so that the centres of pins and axis of strut may not coincide, or the pins may be relatively small and loosely fitted, it is best in such cases to consider the strut as "round ended."

Length. / *Least Radius of Gyration.*	*Fixed Ends.*	*Flat Ends.*	*Hinged Ends.*	*Round Ends.*
20	14380	14380	13940	13330
30	13030	13030	12460	11670
40	11760	11760	11110	10140
50	10860	10860	10130	8930
60	10000	10000	9230	7820
70	9190	9190	8330	6850
80	8420	8420	7500	5950
90	7950	7920	6840	5230
100	7500	7450	6220	4560
110	7070	6840	5620	3980
120	6670	6260	5060	3440
130	6220	5790	4580	2960
140	5800	5340	4120	2510
150	5390	4830	3570	2120
160	5000	4350	3060	1760
170	4570	3920	2640	1530
180	4170	3500	2250	1310
190	3830	3190	2020	1150
200	3500	2900	1800	1000
210	3190	2670	1590	890
220	2880	2440	1400	790
230	2640	2250	1260	720
240	2410	2070	1140	650
250	2180	1910	1040	600
260	1960	1750	940	550
270	1840	1610	870	500
280	1720	1460	790	440
290	1610	1330	730	410
300	1500	1200	670	370
310	1390	1080	620	350
320	1290	970	580	320
330	1190	880	540	290
340	1090	800	490	260
350	1040	720	450	240
360	980	650	420	230
370	920	580	380	210
380	850	510	340	200
390	800	470	310	80
400	740	430	280	70

STEEL STRUTS.—No. 3.

Destructive pressure in pounds per square inch, for steel of medium grade, tensile strength, about 70,000 lbs. per square inch.

For extreme soft steel, use table No. 1 for wrought iron.

Length. / *Least Radius of Gyration.*	*Fixed Ends.*	*Flat Ends.*	*Hinged Ends.*	*Round Ends.*
20	70000	70000	70000	66900
30	51000	51000	51000	47700
40	46000	46000	46000	41900
50	44000	44000	44000	38800
60	42000	42000	42000	35600
70	40000	40000	39700	32600
80	38000	38000	37400	29700
90	36100	36000	34700	26500
100	34200	34000	31900	23400
110	33100	32000	29800	21100
120	31900	30000	27700	18800
130	30100	28000	25500	16500
140	28200	26000	23200	14200
150	26800	24000	20700	12300
160	25300	22000	18100	10400
170	23400	20000	15900	9240
180	21400	18000	13700	8030
190	19400	16200	12200	6990
200	17900	14800	11000	6120
210	16200	13600	9800	5500
220	15000	12700	8800	5000
230	14000	11950	8100	4650
240	13000	11200	7500	4300
250	12000	10500	7000	4050
260	11000	9800	6500	3800
270	10500	9150	6100	3500
280	10000	8500	5700	3200
290	9500	7850	5330	3000
300	9000	7200	5000	2800

STEEL STRUTS.—No. 4.

Greatest safe load for steel of medium grade, tensile strength about 70,000 lbs.
For extreme soft steel, use table No. 2 for wrought iron.
The figures are the working loads in pounds per square inch for vertical struts.
Both ends are supposed to be secured as indicated at the head of each column.
If both ends are not secured alike, take a mean proportional between the values given for the classes to which each end belongs.
If the strut is hinged by any uncertain method so that the centres of pins and axis of strut may not coincide, or the pins may be relatively small and loosely fitted, it is best in such cases to consider the strut as "round ended."

Length. / *Least Radius of Gyration.*	*Fixed Ends.*	*Flat Ends.*	*Hinged Ends.*	*Round Ends.*
20	21900	21900	21200	20300
30	15400	15400	14800	13800
40	13500	13500	12800	11600
50	12600	12600	11700	10300
60	11700	11700	10800	9130
70	10800	10800	9800	8050
80	10000	10000	8900	7070
90	9260	9230	7980	6090
100	8550	8500	7090	5200
110	8070	7800	6410	4540
120	7590	7140	5770	3920
130	7000	6510	5150	3330
140	6410	5910	4550	2780
150	5950	5330	3940	2340
160	5500	4780	3350	1920
170	4980	4250	2860	1660
180	4460	3750	2400	1410
190	3960	3310	2080	1190
200	3580	2960	1830	1020
210	3180	2670	1590	890
220	2880	2440	1400	790
230	2640	2250	1250	720
240	2410	2070	1140	650
250	2180	1910	1040	600
260	1960	1750	940	550
270	1840	1610	860	500
280	1720	1460	790	440
290	1610	1330	720	410
300	1500	1200	670	370

STEEL STRUTS.—No. 5.

Destructive pressure in pounds per square inch for hard steel, tensile strength about 100,000 lbs.

For softer steel, see table No. 3.

Length. / *Least Radius of Gyration.*	*Fixed Ends.*	*Flat Ends.*	*Hinged Ends.*	*Round Ends.*
20	100000	100000	100000	95600
30	74000	74000	74000	69300
40	62000	62000	62000	56600
50	60000	60000	60000	52900
60	58000	58000	58000	49100
70	55500	55500	55100	45300
80	53000	53000	52200	41400
90	49900	49700	47800	36600
100	46800	46500	43700	32000
110	44700	43200	40400	28500
120	42600	40000	36900	25100
130	39400	36700	33500	21600
140	36300	33500	29900	18200
150	34200	30700	26500	15700
160	32200	28000	23100	13300
170	29800	25500	20300	11800
180	27400	23000	17500	10300
190	25100	21000	15800	9060
200	22900	19000	14100	7860
210	20300	17200	12400	6950
220	18300	15500	10700	6100
230	16900	14400	9820	5600
240	15500	13400	8960	5140
250	14200	12400	8270	4780
260	12900	11500	7630	4460
270	12200	10600	7060	4050
280	11400	9700	6500	3650
290	10900	9000	6130	3440
300	10600	8500	5890	3300

STEEL STRUTS.—No. 6.

Greatest safe load for hard steel, tensile strength about 100,000 lbs.
For soft steel, see table No. 4.
The figures are the working loads in pounds per square inch for vertical struts.
Both ends are supposed to be secured as indicated at the head of each column.
If both ends are not secured alike, take a mean proportional between the values given for the classes to which each end belongs.
If the strut is hinged by any uncertain method, so that the centres of pins and axis of strut may not coincide, or the pins may be relatively small and loosely fitted, it is best in such cases to consider the strut as "round ended."

Length. / *Least Radius of Gyration.*	*Fixed Ends.*	*Flat Ends.*	*Hinged Ends.*	*Round Ends.*
20	31200	31200	30300	29000
30	22400	22400	21400	20100
40	18200	18200	17200	15700
50	17100	17100	16000	14100
60	16100	16100	14900	12600
70	15000	15000	13600	11200
80	13900	13900	12400	9860
90	12800	12700	11000	8410
100	11700	11600	9710	7110
110	10900	10500	8670	6130
120	10100	9520	7690	5230
130	9160	8530	6770	4360
140	8250	7610	5860	3570
150	7600	6820	5050	2990
160	7000	6090	4280	2460
170	6340	5420	3660	2130
180	5710	4790	3070	1810
190	5120	4280	2700	1550
200	4580	3800	2350	1310
210	3980	3370	2020	1130
220	3520	2980	1700	970
230	3190	2720	1500	870
240	2870	2480	1360	780
250	2580	2250	1220	710
260	2300	2050	1100	650
270	2240	1860	1000	570
280	1960	1670	900	510
290	1850	1520	830	470
300	1800	1420	780	440

ROLLED STRUCTURAL SHAPES AS STRUTS.

The following tables of safe loads for rolled struts of iron or steel are derived from previous tables, Nos. 2 and 4, and from the columns given for flat-ended bearings. In all cases the strut is supposed to be vertical. In short struts this distinction is immaterial, but in long horizontal struts some allowance is necessary for the deflection due to weight.

If the struts are rigidly connected at the ends to contiguous parts of a structure, the increase of resistance becomes considerable in extremely long struts, and proper allowance can be made by using the columns for "Fixed Ends" in tables Nos. 2 and 4. On the contrary, if the end bearing of the strut is to be of uncertain character or fit, it will be best to reduce the safe load to that in the columns for "Round Ends," in the same tables. In these working tables the calculations are made to apply to the mean thicknesses of each shape. Where more exact results are required for thicknesses above or below the mean, the true radius of gyration of the section will be found on pages 156 to 170. But within the range of variation of thickness possible for any shape the tables may be accepted as practically correct.

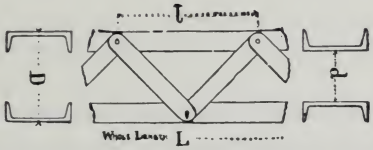
For I beams tables Nos. 7 to 8 apply to cases where the strut is braced in the direction of the flanges, so that failure could occur in the direction of the web only. For unbraced I struts use tables Nos. 9 and 10. Likewise for channel bars used as struts, and braced to resist failure in the directions of the flanges, use tables Nos. 19 to 20, same as for latticed channels.

For a pair of latticed channels, which form a more perfect column than single rolled sections, the safe loads are given for various conditions of the end bearings, as described on pages 180 and 181. On the tables Nos. 19 to 20 the distances D or d for flanges inward or outward, respectively, make the radii of gyration equal for either direction of axis, parallel to web or to the flanges.

Under each length of struts in the table, l represents the greatest distance apart in feet that centres of lateral bracing

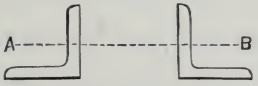
can be spaced, without allowing weakness in the individual channels. The distance l is obtained as shown in last example, that is, by making $\frac{l}{r} = \frac{L}{R}$.

l = length between bracing.
L = total length of strut.
r = least radius of gyration for a single channel.
R = least radius of gyration for the whole section.



It is customary to make l much shorter than given in the tables, the figures given being useful as a guide. If a column is composed of four angles, forming the corners of a square, and properly latticed as described above, find the radius of gyration of the combined section, as described on page 176, and then the working resistance from tables Nos. 2 to 6, or the safe load can be ascertained approximately from tables Nos. 24–25 and page 212 for square columns.

When a pair of angles are tied together forming a single strut



take the greatest radius of gyration, around axis A B, in table No. VII, page 156, for a single angle as the least radius of gyration of the pair, and proceed as before described.

PENCOYD I BEAM AS STRUTS.—No. 7.

Greatest safe load in pounds per square inch of section.

FOR IRON.

For struts secured against failure in the direction of the flanges and liable to bend only in the direction of the web.

Length in Feet.	*SIZE OF BEAM IN INCHES, with Radius of Gyration for Mean Thickness of Each Size.*										
	15 r=5.81	12 r=4.66	10½ r=4.15	10 r=3.93	9 r=3.57	8 r=3.17	7 r=2.79	6 r=2.39	5 r=1.99	4 r=1.57	3 r=1.18
4	15000	15000	14930	14870	14810	14690	14560	14380	13840	12970	11670
6	14870	14690	14560	14500	14380	13970	13570	13030	12270	11220	9920
8	14650	14300	13970	13790	13460	13000	12470	11750	11020	9920	8350
10	14300	13610	13180	12970	12570	12040	11490	10840	9980	8650	7350
12	13730	12920	12450	12190	11730	11270	10720	9980	9010	7840	6170
14	13180	12270	11710	11520	11130	10600	9980	9180	8200	7030	5220
16	12650	11650	11200	10970	10540	9960	9290	8400	7620	6150	4230
18	12130	11190	10690	10440	9960	9340	8620	7900	6930	5450	3410
20	11640	10730	10190	9920	9420	8750	8120	7430	6230	4700	2820
22	11270	10330	9710	9410	8890	8250	7700	6800	5670	4000	2370
24	10890	9850	9250	8870	8390	7880	7250	6240	5100	3390	2000
26	10540	9430	8790	8470	8050	7530	6730	5770	4500	2940	1690
28	10190	9030	8370	8150	7730	7080	6240	5310	3970	2580	1400
30	9840	8630	8080	7840	7400	6630	5840	4800	3470	2260	1140
32	9500	8300	7800	7550	6990	6200	5450	4320	3100	2000	
34	9170	8040	7530	7220	6590	5850	5020	3890	2790	1750	
36	3850	7790	7260	6850	6210	5510	4600	3470	2510	1530	
38	8540	7550	6850	6490	5900	5150	4200	3170	2280	1320	

PENCOYD I BEAM AS STRUTS.—No. 8.

Greatest safe load in pounds per square inch of section.

FOR STEEL OF MEDIUM GRADE.

For struts secured against failure in the direction of the flanges and liable to bend only in the direction of the web.

Length in Feet.	*SIZE OF BEAM IN INCHES, with Radius of Gyration for Mean Thickness of Each Size.*										
	15 r = 5.81	12 r = 4.66	10½ r = 4.15	10 r = 3.93	9 r = 3.57	8 r = 3.17	7 r = 2.79	6 r = 2.39	5 r = 1.99	4 r = 1.57	3 r = 1.18
4	22740	22600	22500	22420	22330	22210	22070	21900	19240	15300	13410
6	22410	22190	22050	21980	21860	20210	18130	15380	14240	12980	11610
8	22110	21510	19880	19040	17480	15360	14560	13490	12760	11600	9900
10	21440	18190	16110	15300	14720	13910	13230	12510	11670	10240	8380
12	18780	15220	14520	14140	13450	13010	12450	11680	10610	9100	7010
14	16110	14260	13450	13250	12870	12330	11680	10780	9690	8010	5780
16	14830	13390	12940	12700	12260	11650	10900	9970	8760	7000	4630
18	14050	12930	12420	12150	11650	10980	10200	9200	7900	6050	3620
20	13380	12510	11890	11610	11050	10340	9530	8470	7100	5170	2860
22	13010	12000	11370	10930	10480	9750	8890	7770	6350	4350	2370
24	12640	11540	10860	10600	9950	9170	8270	7100	5630	3600	2000
26	12260	11070	10390	10050	9430	8620	7680	6480	4960	3000	1690
28	11890	10630	9930	9580	8930	8080	7110	5880	4310	2580	1400
30	11520	10220	9480	9110	8440	7560	6570	5290	3710	2260	1140
32	10990	9810	9070	8650	7970	7070	6050	4750	3210	2000	
34	10780	9420	8620	8230	7520	6590	5550	4210	2810	1750	
36	10450	9030	8220	7800	7070	6130	5060	3720	2510	1530	
38	10120	8660	7810	7400	6650	5740	4600	3280	2280	1320	

PENCOYD I BEAMS AS STRUTS.—No. 9.

Greatest safe load in pounds per square inch of section.

FOR IRON.

When the struts are unsupported, or free to bend in the direction of the flanges.

r = radius of gyration for the mean thicknesses of each shape.

Section Number.	Size of Beam in Inches.		LENGTH IN FEET.									
			4	6	8	10	12	14	16	18	20	22
1	15	$r = 1.17$	11670	9870	8320	7290	6110	5160	4170	3350	2780	2330
2		$r = 1.04$	11210	9340	7810	6530	5410	4280	3360	2720	2230	1850
521		$r = 1.08$	11360	9460	7980	6340	5640	4560	3590	2900	2400	2000
3	12	$r = 1.15$	11600	9790	8250	7180	6010	5030	4050	3250	2700	2260
4		$r = .99$	11000	8980	7590	6200	5060	3930	3070	2480	2030	1650
515		$r = .97$	10910	8860	7500	6080	4910	3790	2960	2390	1950	1570
5	$10\frac{1}{2}$	$r = 1.17$	11670	10870	8320	7290	6110	5160	4170	3350	2780	2330
$5\frac{1}{2}$		$r = 1.05$	11240	9310	7850	6590	5470	4350	3410	2750	2270	1880
6		$r = .95$	10810	8750	7380	5960	4750	3630	2850	2300	1860	1490
7	10	$r = .96$	10860	8800	7450	6020	4830	3710	2900	2340	1910	1530
8		$r = .94$	10770	8690	7320	5900	4680	3550	2800	2250	1820	1450
511		$r = .89$	10520	8370	6970	5570	4270	3230	2530	2020	1610	1240
9	9	$r = 1.00$	11040	9030	7630	6260	5130	4000	3130	2530	2070	1690
10		$r = .88$	10470	8330	6900	5500	4190	3160	2480	1980	1570	1200
509		$r = .86$	10360	8230	6740	5360	4060	3030	2380	1890	1470	1110
11	8	$r = .94$	10770	8690	7320	5900	4680	3550	2800	2250	1820	1450
12		$r = .84$	10250	8130	6590	5190	3860	2900	2270	1790	1380	
507		$r = .82$	10120	8030	6430	5010	3680	2790	2170	1700	1290	
13	7	$r = .78$	9870	7810	6110	4640	3350	2540	1970	1500	1100	
14		$r = .80$	10000	7920	6260	4830	3500	2670	2070	1610	1200	
505		$r = .79$	9990	7860	6190	4740	3430	2610	2020	1550	1150	
23	6	$r = 1.25$	11960	10200	8660	7630	6530	5590	4650	3800	3130	2640
24		$r = 1.12$	11500	9660	8130	7010	5860	4830	3860	3100	2570	2140
15		$r = .86$	10360	8230	6740	5360	4080	3030	2380	1890	1470	1110
16		$r = .75$	9670	7630	5880	4350	3130	2360	1810	1350		
503		$r = .70$	9310	7280	5470	3860	2760	2070	1540	1090		
17	5	$r = .62$	8620	6480	4600	3080	2210	1600	1080			
18		$r = .63$	8720	6590	4720	3170	2270	1650	1140			
	4	$r = .54$	7980	5640	3590	2390	1650	1070				
	3	$r = .53$	7890	5520	3460	2310	1490					

PENCOYD I BEAMS AS STRUTS.—No. 10.

Greatest safe load in pounds per square inch of section.

FOR STEEL OF MEDIUM GRADE.

When the struts are unsupported, or free to bend in the direction of the flanges.

r = least radius of gyration for mean thickness of each shape.

Section Number.	Size of Beam in Inches.		LENGTH IN FEET.									
			4	6	8	10	12	14	16	18	20	22
1	15	$r = 1.17$	13490	11560	9840	8320	6950	5700	4560	3540	2810	2330
2		$r = 1.04$	12950	11870	9060	7450	6000	4700	3540	2730	2230	1850
521		$r = 1.08$	13100	11100	9320	7800	6310	5020	3860	2960	2400	2000
3	12	$r = 1.15$	13340	11460	9730	8190	6810	5560	4410	3400	2710	2260
4		$r = 0.99$	12740	10580	8720	7060	5590	4270	3150	2480	2030	1650
515		$r = 0.97$	12650	10460	8580	6900	5420	4090	3040	2390	1950	1570
5	10½	$r = 1.17$	13490	11560	9840	8320	6950	5700	4560	3540	2810	2330
51½		$r = 1.05$	12980	10930	9120	7520	6080	4780	3620	2790	2270	1880
6		$r = 0.95$	12550	10350	8430	6740	5240	3910	2900	2300	1860	1490
7	10	$r = 0.96$	12600	10400	8500	6820	5330	4000	2960	2340	1910	1530
8		$r = 0.94$	12510	12280	8350	6660	5160	3810	2830	2250	1820	1450
511		$r = 0.89$	12240	9930	7950	6220	4690	3360	2530	2020	1619	1240
9	9	$r = 1.00$	12780	10640	8790	7140	5670	4350	3240	2530	2070	1690
10		$r = 0.88$	12190	9860	7870	6130	4590	3270	2480	1980	1570	1200
509		$r = 0.86$	12070	9710	7690	5940	4430	3120	3380	1890	1470	1110
11	8	$r = 0.94$	12510	10280	8350	6660	5160	3810	2830	2250	1820	1450
12		$r = 0.84$	11960	9560	7520	5740	4180	2960	2270	1790	1380	
507		$r = 0.82$	11830	9400	7330	5540	3970	2820	2170	1700	1290	
13	7	$r = 0.78$	11560	9060	6950	5120	3540	2540	1970	1500	1100	
14		$r = 0.80$	11700	9230	7140	5330	3750	2670	2070	1610	1200	
505		$r = 0.79$	11610	9150	7040	5230	3650	2610	2020	1550	1150	
23	6	$r = 1.25$	13800	11910	10250	8790	7450	6240	5130	4110	3240	2640
24		$r = 1.12$	13240	11320	9560	8000	6600	5330	4180	3210	2570	2140
15		$r = 0.86$	12070	9710	7690	5940	4430	3120	2380	1890	1470	1110
16		$r = 0.75$	11340	8790	6630	4780	3240	2360	1810	1350		
503		$r = 0.70$	10930	8280	6080	4180	2780	2070	1540	1090		
17	5	$r = 0.62$	10200	7390	5080	3180	2210	1600	1080			
18		$r = 0.63$	10310	7520	5200	3300	2270	1650	1140			
	4	$r = 0.54$	9320	6310	3860	2390	1650	1070				
	3	$r = 0.53$	9190	6160	3700	2310	1590					

PENCOYD ANGLES AS STRUTS.—No. 11.

Greatest safe load in pounds per square inch of section.

FOR IRON.

r = least radius of gyration for mean thickness of each size.

Size of Angles in Inches.	*LENGTH IN FEET.*									
	2	4	6	8	10	12	14	16	18	20
6 x 6 $r = 1.19$	14360	11730	9960	8380	7400	6210	5280	4290	3450	2860
5 x 5 $r = .99$	13810	11000	8980	7590	6200	5060	3930	3070	2480	2030
4 x 4 $r = .79$	12990	9940	7860	6190	4740	3430	2610	2020	1550	1150
$3\frac{1}{2}$ x $3\frac{1}{2}$ $r = .69$	12430	9230	7180	5380	3750	2700	2010	1480		
3 x 3 $r = .59$	11700	8350	6160	4230	2820	2000	1390			
$2\frac{3}{4}$ x $2\frac{3}{4}$ $r = .53$	11290	7890	5520	3460	2310	1580				
$2\frac{1}{2}$ x $2\frac{1}{2}$ $r = .49$	10950	7540	4980	3010	1990	1280				
$2\frac{1}{4}$ x $2\frac{1}{4}$ $r = .44$	10470	6900	4190	2480	1570					
2 x 2 $r = .39$	9870	6110	3350	1970	1100					
$1\frac{3}{4}$ x $1\frac{3}{4}$ $r = .33$	8980	5060	2480	1310						
$1\frac{1}{2}$ x $1\frac{1}{2}$ $r = .29$	8280	4110	1930							
$1\frac{1}{4}$ x $1\frac{1}{4}$ $r = .26$	7810	3350	1500							
1 x 1 $r = .21$	6590	2270								

PENCOYD ANGLES AS STRUTS.—No. 12.

Greatest safe load in pounds per square inch of section.

FOR STEEL OF MEDIUM GRADE.

r = least radius of gyration for mean thickness of each size.

Size of Angles in Inches.	*LENGTH IN FEET.*									
	2	4	6	8	10	12	14	16	18	20
6 x 6 $r = 1.19$	21830	13470	11650	9940	8440	7070	5840	4710	3680	2910
5 x 5 $r = .99$	19170	12740	10580	8720	7060	5590	4270	3170	2480	2030
4 x 4 $r = .79$	15370	11630	9150	7040	5230	3650	2610	2020	1550	1150
$3\frac{1}{2}$ x $3\frac{1}{2}$ $r = .69$	14970	10840	8190	5970	4050	2710	2010	1480		
3 x 3 $r = .59$	13440	9900	7010	4630	2860	2000	1390			
$2\frac{3}{4}$ x $2\frac{3}{4}$ $r = .53$	13030	9190	6160	3700	2310	1580				
$2\frac{1}{2}$ x $2\frac{1}{2}$ $r = .49$	12690	8650	5510	3100	1990	1280				
$2\frac{1}{4}$ x $2\frac{1}{4}$ $r = .44$	12190	7870	4590	2480	1570					
2 x 2 $r = .39$	11560	6950	3540	1970	1100					
$1\frac{3}{4}$ x $1\frac{3}{4}$ $r = .33$	10580	5590	2480	1310						
$1\frac{1}{2}$ x $1\frac{1}{2}$ $r = .29$	9790	4480	1930							
$1\frac{1}{4}$ x $1\frac{1}{4}$ $r = .26$	9060	3540	1500							
1 x 1 $r = .21$	7520	2270								

PENCOYD Z BARS AS STRUTS.—No. 13.

Greatest safe load in pounds per square inch of section.

FOR IRON.

When struts are unsupported, or free to bend in the direction of the flanges.

r = least radius of gyration for mean thickness of each size.

Section. No.	Size in Inches.	LENGTH IN FEET.								
		2	4	6	8	10	12	14	16	18
220 $r = .54$	$2\frac{1}{16}\times3\frac{1}{16}\times2\frac{1}{16}\times\frac{5}{16}$	11360	7980	5640	3590	2390	1650			
221 $r = .55$	$2\frac{1}{16}\times3\frac{1}{32}\times2\frac{1}{16}\times\frac{5}{32}$	11430	8060	5740	3730	2480	1720	1130		
222 $r = .64$	$2\frac{5}{16}\times4\frac{1}{16}\times2\frac{5}{16}\times\frac{5}{16}$	12070	8800	6690	4830	3260	2340	1710	1200	
223 $r = .64$	$3\frac{1}{32}\times4\frac{1}{16}\times3\frac{1}{32}\times\frac{1}{2}$	12070	8800	6690	4830	3260	2340	1710	1200	
224 $r = .65$	$3\frac{1}{8}\times4\frac{1}{16}\times3\frac{1}{8}\times\frac{11}{16}$	12150	8890	6800	4950	3350	2410	1770	1260	
225 $r = .73$	$3\frac{1}{4}\times5\frac{1}{16}\times3\frac{1}{4}\times\frac{3}{8}$	12670	9530	7510	5720	4160	2980	2240	1700	1250
226 $r = .74$	$3\frac{9}{32}\times5\frac{1}{16}\times3\frac{9}{32}\times\frac{9}{16}$	12720	9610	7580	5800	4250	3050	2300	1760	1300
227 $r = .73$	$3\frac{9}{32}\times5\frac{1}{32}\times3\frac{9}{32}\times\frac{23}{32}$	12670	9530	7510	5720	4160	2980	2240	1700	1250
228 $r = .83$	$3\frac{9}{16}\times6\frac{1}{16}\times3\frac{9}{16}\times\frac{7}{16}$	13170	10180	8080	6510	5110	3770	2840	2220	1740
229 $r = .81$	$3\frac{9}{16}\times6\frac{1}{16}\times3\frac{9}{16}\times\frac{5}{8}$	13080	10060	7980	6340	4920	3590	2730	2120	1650
230 $r = .81$	$3\frac{9}{16}\times6\frac{1}{16}\times3\frac{9}{16}\times1\frac{3}{16}$	13080	10060	7980	6340	4920	3590	2730	2120	1650

PENCOYD Z BARS AS STRUTS.—No. 14.

Greatest safe load in pounds per square inch of section.

FOR STEEL OF MEDIUM GRADE.

When struts are unsupported, or free to bend in the direction of the flanges.

r = least radius of gyration for mean thickness of each size.

Section. No.	*Size in Inches.*	*LENGTH IN FEET.*								
		2	4	6	8	10	12	14	16	18
220 $r = .54$	$2\frac{1}{16} \times 3\frac{1}{16} \times 2\frac{1}{16} \times \frac{5}{16}$	13100	9320	6310	3860	2390	1650			
221 $r = .55$	$2\frac{1}{16} \times 3\frac{1}{32} \times 2\frac{1}{16} \times \frac{5}{32}$	13170	9440	6450	4020	2480	1720	1130		
222 $r = .64$	$2\frac{5}{16} \times 4\frac{1}{16} \times 2\frac{5}{16} \times \frac{5}{16}$	13970	10400	7630	5330	3420	2340	1710	1200	
223 $r = .64$	$3\frac{1}{32} \times 4\frac{1}{16} \times 3\frac{1}{32} \times \frac{1}{2}$	13970	10400	7630	5330	3420	2340	1710	1200	
224 $r = .65$	$3\frac{1}{8} \times 4\frac{1}{16} \times 3\frac{1}{8} \times \frac{11}{16}$	14080	10490	7750	5470	3540	2410	1770	1260	
225 $r = .73$	$3\frac{1}{4} \times 5\frac{1}{16} \times 3\frac{1}{4} \times \frac{3}{8}$	14860	11180	8600	6420	4550	3050	2240	1700	1250
226 $r = .74$	$3\frac{9}{32} \times 5\frac{1}{16} \times 3\frac{9}{32} \times \frac{9}{16}$	14940	11260	8700	6520	4660	3150	2300	1760	1300
227 $r = .73$	$3\frac{9}{32} \times 5\frac{1}{32} \times 3\frac{9}{32} \times \frac{23}{32}$	14860	11180	8600	6420	4550	3050	2240	1700	1250
228 $r = .83$	$3\frac{9}{16} \times 6\frac{1}{16} \times 3\frac{9}{16} \times \frac{7}{16}$	16110	11890	9480	7430	5640	4080	2890	2220	1740
229 $r = .81$	$3\frac{9}{16} \times 6\frac{1}{16} \times 3\frac{9}{16} \times \frac{5}{8}$	15660	11770	9320	7230	5440	3860	2740	2120	1650
230 $r = .81$	$3\frac{9}{16} \times 6\frac{1}{16} \times 3\frac{9}{16} \times \frac{13}{16}$	15660	11770	9320	7230	5440	3860	2740	2120	1650

PENCOYD TEES AS STRUTS.—No. 15.

Greatest safe load in pounds per square inch of section.

FOR IRON.

r = least radius of gyration of each size.

Size of Tees. Inches.	*LENGTH IN FEET.*									
	2	4	6	8	10	12	14	16	18	20
4 x 4 r = .85	13270	10340	8180	6670	5280	3940	2970	2330	1840	1430
3½ x 3½ r = .74	12780	9610	7580	5800	4260	3060	2300	1760	1300	930
3 x 3 r = .62	11920	8620	6480	4600	3030	2210	1590	1030	730	
2½ x 2½ r = .53	11290	7890	5520	3460	2310	1580	1140			
2¼ x 2¼ r = .47	10770	7320	4680	2800	1820	1120	670			
2 x 2 r = .43	10360	6740	4030	2370	1470	840				
1¾ x 1¾ r = .37	9610	5800	3060	1760	930					
1½ x 1½ r = .32	8800	4830	2340	1200	540					
1¼ x 1¼ r = .27	7980	3590	1650	670						
1 x 1 r = .26	7810	3350	1500	580						

PENCOYD TEES AS STRUTS.—No. 16.

Greatest safe load in pounds per square inch of section.

FOR STEEL OF MEDIUM GRADE.

r = least radius of gyration of each size.

Size of Tees. Inches.	*LENGTH IN FEET.*									
	2	4	6	8	10	12	14	16	18	20
4 x 4 $r = .85$	16570	12020	9630	7600	6840	4280	3040	2330	1840	1430
$3\frac{1}{2}$ x $3\frac{1}{2}$ $r = .74$	14940	11260	8700	6510	4660	3150	2300	1760	1300	930
3 x 3 $r = .62$	13740	10200	7390	5060	3180	2210	1590	1080	730	
$2\frac{1}{2}$ x $2\frac{1}{2}$ $r = .53$	13030	9190	6160	3700	2310	1580	1140			
$2\frac{1}{4}$ x $2\frac{1}{4}$ $r = .47$	12510	8350	5160	2830	1820	1120	670			
2 x 2 $r = .43$	12070	7690	4380	2370	1470	840				
$1\frac{3}{4}$ x $1\frac{3}{4}$ $r = .37$	11260	6520	3140	1760	930					
$1\frac{1}{2}$ x $1\frac{1}{2}$ $r = .32$	10400	5330	2340	1200	540					
$1\frac{1}{4}$ x $1\frac{1}{4}$ $r = .27$	9320	3860	1650	670						
1 x 1 $r = .26$	9060	3540	1500	580						

PENCOYD CHANNELS AS STRUTS.—No. 17.

Greatest safe load in pounds per square inch of section.

FOR IRON.

When struts are unsupported, or free to bend in the direction of the flanges.
r = least radius of gyration for mean thickness of each shape.

Section Number.	Size of Channel in Inches.	LENGTH IN FEET.									
		2	4	6	8	10	12	14	16	18	20
30	15 $r = 1.08$	14110	11400	9430	7970	6780	5650	4540	3580	2900	2400
53	$r = 1.10$	14110	11400	9590	8070	6900	5740	4690	3710	3020	2490
55	13 $r = 1.07$	14110	11310	9430	7920	6720	5560	4490	3540	2850	2360
31	$r = 0.83$	13170	10170	8070	6490	5080	3790	2850	2230	1750	1340
32	12 $r = 0.70$	12520	9270	7270	5470	3880	2760	2070	1550	1090	
427	$r = 0.87$	13300	10430	8270	6840	5430	4090	3100	2420	1940	1520
34	10 $r = 0.77$	12900	9840	7730	6030	4540	3280	2490	1930	1450	
35	$r = 0.71$	12520	9350	7390	5560	3960	2830	2120	1610	1150	
36	9 $r = 0.72$	12650	9430	7450	5650	4050	2900	2200	1650	1200	
37	$r = 0.64$	12010	8800	6670	4830	3250	2350	1690	1200		
418	8 $r = 0.71$	12520	9350	7390	5560	3960	2830	2120	1610	1150	
419	$r = 0.62$	11890	8650	6490	4590	3070	2210	1590	1080		
40	7 $r = 0.65$	12140	8880	6780	4930	3340	2400	1780	1260		
41	$r = 0.56$	11490	8120	5840	3880	2580	1800	1200			
42	6 $r = 0.65$	12140	8880	6780	4930	3340	2400	1780	1260		
44	$r = 0.50$	11040	7640	5140	3130	2070	1360				
412	5 $r = 0.60$	11760	8420	6260	4350	2900	2070	1460			
47	4 $r = 0.50$	11040	7640	5140	3130	2070	1360				
48	$r = 0.46$	10690	7210	4490	2690	1740					
49	3 $r = 0.42$	10260	6610	3880	2270	1380					

PENCOYD CHANNELS AS STRUTS.—No. 18.

Greatest safe load in pounds per square inch of section.

FOR STEEL OF MEDIUM GRADE.

When the struts are unsupported, or free to bend in the direction of the flanges.
r = least radius of gyration for mean thickness of each shape.

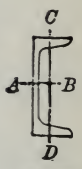
Section Number.	Size of Channel in Inches.	LENGTH IN FEET.									
		2	4	6	8	10	12	14	16	18	20
30	15 $r = 1.08$	20600	13140	11070	9310	7730	6330	5000	3850	2960	2400
53	15 $r = 1.10$	20600	13140	11250	9460	7870	6450	5160	4000	3100	2490
55	13 $r = 1.07$	20600	13050	11070	9230	7670	6210	4940	3800	2900	2360
31	12 $r = 0.83$	16050	11880	9460	7400	5620	4100	2900	2230	1750	1340
32	12 $r = 0.70$	14640	10890	8290	6090	4200	2790	2070	1550	1090	
427	12 $r = 0.87$	16700	12150	9770	7800	6030	4460	3200	2420	1940	1520
34	10 $r = 0.77$	15210	11520	8940	6820	5000	3400	2490	1930	1450	
35	10 $r = 0.71$	14640	10980	8430	6210	4300	2870	2120	1610	1150	
36	9 $r = 0.72$	14830	11070	8500	6330	4410	2960	2200	1650	1200	
37	9 $r = 0.64$	13880	10400	7600	5330	3400	2380	1690	1200		
418	8 $r = 0.71$	14640	10980	8430	6210	4300	2870	2120	1610	1150	
419	8 $r = 0.62$	13690	10240	9400	5050	3170	2210	1590	1080		
40	7 $r = 0.65$	14070	10480	7730	5450	3530	2400	1780	1260		
41	7 $r = 0.56$	13230	9540	6570	4200	2550	1800	1200			
417	7 $r = 0.57$	13320	9690	6760	4360	2650	1860	1260			
42	6 $r = 0.65$	14070	10480	7730	3450	3530	2400	1780	1260		
44	6 $r = 0.50$	12780	8790	5680	3240	2070	1360				
415	6 $r = 0.54$	13140	9310	6330	3850	2400	1660				
412	5 $r = 0.60$	13500	10000	7140	4780	2940	2070	1460			
413	5 $r = 0.50$	12780	8790	5680	3240	2070	1360				
47	4 $r = 0.50$	12780	8790	5680	3240	2070	1360				
48	4 $r = 0.46$	12420	8220	4940	2700	1740					
411	4 $r = 0.46$	12420	8220	4940	2700	1740					
49	3 $r = 0.42$	11970	7540	4200	2270	1380					

TABLE OF STRUTS.—No. 19.

LATTICED CHANNEL STRUTS.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION.

FOR IRON.



For a pair of braced channels, or for a single channel secured from flexure in the direction of flanges and liable to fail only in the direction of the web *C D*.

r in the marginal columns gives the radius of gyration for axis *A B*, or for either axis of the combined pair of channels. See description, page 188.

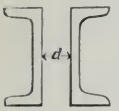
Size of Channels.	*Condition of Ends.*	*LENGTH IN FEET.*								
		6	8	10	12	14	16	18	20	22
15 ins.	Fixed.	15000	14570	14150	13570	12980	12430	11870	11450	11050
$r =$ 5.52	Flat.	15000	14570	14150	13570	12980	12430	11870	11450	11050
$D =$ 12.8	Hinged.	15000	14340	13690	13060	12400	11820	11230	10770	10340
$d =$ 8.8	Round.	15000	14020	13040	12330	11600	10950	10270	9720	9190
		1.18	1.58	1.97	2.37	2.76	3.15	3.55	3.95	4.34
12 ins.	Fixed.	15000	14120	13390	12670	11970	11410	10920	10450	9980
$r =$ 4.38	Flat.	15000	14120	13390	12670	11970	11410	10920	10450	9980
$D =$ 10.1	Hinged.	15000	13660	12870	12080	11340	10730	10190	9700	9210
$d =$ 7.1	Round.	15000	13010	12110	11240	10400	9680	9010	8400	7800
		1.09	1.46	1.83	2.19	2.55	2.92	3.28	3.65	4.01
10 ins.	Fixed.	15000	13590	12730	11910	11290	10710	10150	9620	9100
$r =$ 3.71	Flat.	15000	13590	12730	11910	11290	10710	10150	9620	9100
$D =$ 8.6	Hinged.	15000	13090	12150	11270	10600	9970	9390	8810	8230
$d =$ 5.9	Round.	15000	12360	11310	10320	9510	8740	8020	7370	6750
		1.19	1.59	1.99	2.39	2.79	3.19	3.58	3.98	4.38
9 ins.	Fixed.	14150	13160	12240	11440	10800	10170	9570	8990	8440
$r =$ 3.31	Flat.	14150	13160	12240	11440	10800	10170	9570	8990	8440
$D =$ 7.7	Hinged.	13690	12620	11620	10760	10060	9410	8760	8120	7520
$d =$ 5.2	Round.	13040	11830	10720	9710	8850	8040	7310	6620	5970
		1.23	1.64	2.05	2.46	2.87	3.28	3.70	4.11	4.52
8 ins.	Fixed.	13840	12770	11760	11040	10340	9670	9030	8420	8040
$r =$ 3.0	Flat.	13840	12770	11760	11040	10340	9670	9030	8420	8020
$D =$ 7.1	Hinged.	13350	12190	11110	10320	9590	9190	8160	7500	6970
$d =$ 4.6	Round.	12660	11360	10140	9170	8260	7430	6670	5950	5370
		1.32	1.76	2.20	2.64	3.08	3.52	3.96	4.40	4.84
7 ins.	Fixed.	13310	12110	11170	10360	9580	8850	8240	7810	7400
$r =$ 2.58	Flat.	13310	12110	11170	10360	9580	8850	8230	7770	7310
$D =$ 6.2	Hinged.	12780	11480	10470	9600	8770	7960	7250	6650	6080
$d =$ 3.9	Round.	12010	10560	9350	8280	7320	6450	5680	5020	4420
		1.39	1.86	2.35	2.79	3.25	3.72	4.18	4.65	5.11
6 ins.	Fixed.	12780	11540	10600	9700	8850	8190	7700	7230	6790
$r =$ 2.26	Flat.	12780	11540	10600	9700	8850	8170	7660	7070	6440
$D =$ 5.4	Hinged.	12200	10870	9860	8890	7970	7170	6490	5850	5240
$d =$ 3.3	Round.	11380	9950	8590	7460	6460	5590	4860	4200	3610
		1.51	2.01	2.52	3.02	3.44	4.25	4.54	5.04	5.54

TABLE OF STRUTS.—No. 19.

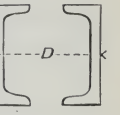
LATTICED CHANNEL STRUTS.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION

FOR IRON.



The channels must be connected so as to insure unity of action, and separated not less than the distances D or d respectively given in inches in the marginal column. Figures in smaller type under each length represent the greatest distance apart in feet on each channel that centres of lateral bracing should be placed.



LENGTH IN FEET.									*Condition of Ends.*	*Size of Channels.*
24	26	28	30	32	34	36	38	40		
10680	10300	9930	9570	9230	8890	8550	8290	8110	Fixed.	**15** ins.
10680	10300	9930	9570	9230	8890	8550	8290	8070	Flat.	$r = 5.52$
9940	9540	9150	8760	8370	8000	7650	7320	7040	Hinged.	$D = 12.8$
8690	8200	7740	7310	6890	6490	6110	5760	5450	Round.	$d = 8.8$
4.74	5.13	5.53	5.92	6.32	6.71	7.11	7.50	7.90		
9530	9090	8670	8320	8060	7810	7560	7320	7090	Fixed.	**12** ins.
9530	9090	8670	8320	8040	7770	7510	7200	6870	Flat.	$r = 4.38$
8710	8230	7770	7360	6990	6640	6300	5970	5650	Hinged.	$D = 10.1$
7260	6740	6240	5790	5400	5020	4650	4320	4000	Round.	$d = 7.1$
4.38	4.74	5.11	5.47	5.84	6.21	6.57	6.94	7.30		
8300	8220	7920	7630	7350	7070	6810	6540	6250	Fixed.	**10** ins.
8600	8210	7890	7590	7230	6840	6460	6120	5820	Flat.	$r = 3.71$
7700	7230	6800	6400	6010	5620	5260	4920	4610	Hinged.	$D = 8.6$
6160	5650	5190	4760	4350	3980	3630	3300	2990	Round.	$d = 5.9$
4.78	5.18	5.58	5.98	6.38	6.78	7.18	7.58	7.98		
8090	7760	7430	7120	6830	6520	6190	5890	5590	Fixed.	**9** ins.
8070	7720	7350	6920	6490	6110	5760	5440	5080	Flat.	$r = 3.31$
7030	6580	6130	5690	5280	4900	4550	4220	3840	Hinged.	$D = 7.7$
5440	4760	4470	4050	3650	3280	2930	2610	2310	Round.	$d = 5.2$
4.93	5.31	5.75	6.16	6.57	6.98	7.39	7.81	8 21		
7680	7320	6990	6670	6310	5960	5630	5310	5000	Fixed.	**8** ins.
7630	7200	6720	6260	5880	5520	5150	4730	4350	Flat.	$r = 3.0$
6460	5980	5500	5060	4670	4300	3900	3460	3060	Hinged.	$D = 7.1$
4820	4320	3870	3440	3050	2690	2350	2040	1760	Round.	$d = 4.6$
5.28	5.72	6.16	6.60	7.04	7.48	7.92	8.36	8.80		
7000	6630	6210	5820	5400	5070	4680	4300	3960	Fixed.	**7** ins.
6740	6210	5780	5360	4890	4440	4030	3630	3310	Flat.	$r = 2.58$
5530	5010	4570	4140	3630	3150	2750	2370	2110	Hinged.	$D = 6.2$
3890	3390	2950	2530	2160	1820	1590	1380	1200	Round.	$d = 3.9$
5.57	6.04	6.51	6.97	7.44	7.91	8.37	8.83	9.30		
6330	5880	5440	5050	4570	4150	3790	3440		Fixed.	**6** ins.
5910	5430	4900	4380	3920	3480	3160	2860		Flat.	$r = 2.26$
4700	4210	3640	3100	2640	2230	1990	1760		Hinged.	$D = 5.4$
3080	2600	2170	1780	1520	1300	1130	980		Round.	$d = 3.3$
6.05	6.55	7.06	7.56	8.11	8.57	9.08	9.58			

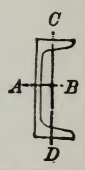
TABLE OF STRUTS.—No. 20.

LATTICED CHANNEL STRUTS.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION.

FOR STEEL of Medium Grade.

For a pair of braced channels, or for a single channel secured from flexure in the direction of flanges and liable to fail only in the direction of the web *C D*.



r in the marginal columns gives the radius of gyration for axis *A B*, or for either axis of the combined pair of channels. See description, page 188.

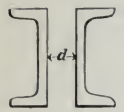
Size of Channels.	*Condition of Ends.*	*LENGTH IN FEET.*								
		6	8	10	12	14	16	18	20	22
15 ins.	Fixed.	20000	20000	20000	18000	15320	14500	13670	13190	12790
$r = 5.52$	Flat.	20000	20000	20000	18000	15320	14500	13670	13190	12790
$D = 12.8$	Hinged.	20000	20000	20000	17360	14720	13860	12980	12420	11940
$d = 8.8$	Round.	20000	20000	19190	16400	13710	12760	11790	11150	10580
		1.18	1.58	1.97	2.37	2.76	3.15	3.55	3.95	4.34
12 ins.	Fixed.	20000	20000	17150	14860	13820	13150	12660	12170	11680
$r = 4.38$	Flat.	20000	20000	17150	14860	13820	13150	12660	12170	11680
$D = 10.1$	Hinged.	20000	19980	16520	14240	13140	12380	11770	11270	10780
$d = 7.1$	Round.	20000	19050	15550	13180	11970	11100	10390	9750	9100
		1.09	1.46	1.83	2.19	2.55	2.92	3.28	3.65	4.01
10 ins.	Fixed.	20000	18130	14960	13720	13030	12440	11860	11280	10710
$r = 3.71$	Flat.	20000	18130	14960	13720	13030	12440	11860	11280	10710
$D = 8.6$	Hinged.	20000	17480	14340	13040	12220	11540	10960	10340	9700
$d = 5.9$	Round.	20000	16530	13290	11860	10920	10100	9340	8630	7940
		1.19	1.59	1.99	2.39	2.79	3.19	3.58	3.98	4.38
9 ins.	Fixed.	20000	16050	14220	13180	12530	11880	11230	10600	10020
$r = 3.31$	Flat.	20000	16050	14220	13180	12530	11880	11230	10600	10020
$D = 7.7$	Hinged.	20000	15440	13560	12410	11630	10980	10280	9570	8920
$d = 5.2$	Round.	19190	14450	12430	11140	10210	9360	8560	7800	7100
		1.23	1.64	2.05	2.46	2.87	3.28	3.70	4.11	4.52
8 ins.	Fixed.	19300	15020	13500	12780	12060	11340	10640	10000	9400
$r = 3.00$	Flat.	19300	15020	13500	12780	12060	11340	10640	10000	9380
$D = 7.1$	Hinged.	18640	14200	12800	11920	11160	10400	9620	8900	8160
$d = 4.6$	Round.	17700	13360	11600	10560	9590	8690	7850	7070	6280
		1.32	1.76	2.20	2.64	3.08	3.52	3.96	4.40	4.84
7 ins.	Fixed.	16760	14030	12910	12070	11240	10440	9720	9040	8440
$r = 2.58$	Flat.	16760	14030	12910	12070	11240	10440	9710	9010	8330
$D = 6.2$	Hinged.	16140	13360	12080	11170	10290	9400	8560	7710	6930
$d = 3.9$	Round.	15160	12210	10750	9620	8580	7610	6700	5820	5040
		1.39	1.86	2.35	2.79	3.25	3.72	4.18	4.65	5.11
6 ins.	Fixed.	15030	13280	12330	11360	10450	9630	8870	8250	7740
$r = 2.26$	Flat.	15030	13280	12330	11360	10450	9620	8820	8070	7350
$D = 5.4$	Hinged.	14420	12530	11430	10430	9410	8450	7490	6670	5970
$d = 3.3$	Round.	13380	11280	9940	8730	7620	6590	5600	4790	4110
		1.51	2.01	2.52	3.02	3.44	4.25	4.54	5.04	5.54

TABLE OF STRUTS.—No. 20.

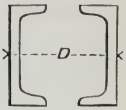
LATTICED CHANNEL STRUTS.

GREATEST SAFE LOAD IN POUNDS PER SQUARE INCH OF SECTION.

FOR STEEL of Medium Grade.



The channels must be connected so as to insure unity of action and separated not less than the distance D or d respectively given in the marginal columns. Figures in small type under each length represent the greatest distance apart in feet on each channel that centres of lateral bracing should be placed.



LENGTH IN FEET.									*Condition of Ends.*	*Size of Channels.*
24	26	28	30	32	34	36	38	40		
12410	12010	11620	11230	10840	10480	10140	9800	9490	Fixed.	**15** ins.
12410	12010	11620	11230	10840	10480	10140	9800	9460	Flat.	$r =$ 5.52
11510	11110	10720	10280	9850	9440	9060	8660	8260	Hinged.	$D =$ 12.8
10050	9540	9040	8560	8100	7660	7240	6810	6390	Round.	$d =$ 8.8
4.74	5.13	5.53	5.92	6.32	6.71	7.11	7.50	7.90		
11180	10700	10260	9840	9430	9040	8650	8350	8090	Fixed.	**12** ins.
11180	10700	10260	9830	9410	9000	8600	8210	7830	Flat.	$r =$ 4.38
10230	9690	9190	8700	8200	7700	7210	6810	6440	Hinged.	$D =$ 10.1
8510	7930	7390	6860	6320	5810	5320	4930	4570	Round.	$d =$ 7.1
4.38	4.74	5.11	5.47	5.84	6.21	6.57	6.94	7.30		
10190	9690	9220	8760	8380	8070	7760	7410	7040	Fixed.	**10** ins.
10190	9680	9190	8710	8250	7800	7370	6950	6550	Flat.	$r =$ 3.71
9110	8520	7930	7350	6850	6410	6000	5590	5190	Hinged.	$D =$ 8.6
7300	6660	6040	5460	4960	4540	4140	3740	3370	Round.	$d =$ 5.9
4.78	5.18	5.58	5.98	6.38	6.78	7.18	7.58	7.98		
9480	8960	8470	8130	7780	7400	6970	6540	6180	Fixed.	**9** ins.
9460	8920	8390	7890	7400	6930	6480	6040	5620	Flat.	$r =$ 3.31
8250	7600	6980	6490	6020	5570	5120	4680	4240	Hinged.	$D =$ 7.7
6380	5710	5100	4620	4160	3730	3300	2900	2560	Round.	$d =$ 5.2
4.93	5.34	5.75	6.16	6.57	6.98	7.39	7.81	8.21		
8830	8350	7970	7590	7110	6640	6220	5860	5500	Fixed.	**8** ins.
8790	8220	7660	7140	6630	6150	5670	5220	4780	Flat.	$r =$ 3.0
7440	6810	6280	5770	5270	4790	4300	3820	3350	Hinged.	$D =$ 7.1
5550	4930	4410	3920	3440	3000	2600	2250	1920	Round.	$d =$ 4.6
5.28	5.70	6.16	6.60	7.04	7.48	7.92	8.36	8.80		
7990	7530	6980	6440	6000	5580	5110	4630	4160	Fixed.	**7** ins.
7690	7080	6480	5940	5400	4880	4380	3910	3480	Flat.	$r =$ 2.58
6300	5710	5130	4580	4010	3460	2980	2550	2200	Hinged.	$D =$ 6.2
4440	3860	3310	2800	2390	2000	1720	1490	1270	Round.	$d =$ 3.9
5.57	6.04	6.51	6.97	7.44	7.91	8.37	8.83	9.30		
7150	6520	6020	5530	4980	4430	3910	3510		Fixed.	**6** ins.
6670	6030	5410	4820	4250	3720	3270	2910		Flat.	$r =$ 2.26
5310	4670	4020	3390	2860	2380	2050	1790		Hinged.	$D =$ 5.4
3480	2890	2400	1950	1660	1390	1170	990		Round.	$d =$ 3.3
6.05	6.55	7.06	7.56	8.11	8.57	9.08	9.58			

COLUMNS OF ROUND AND SQUARE SECTION.

Experiments on columns of this class are not very complete, especially as denoting the comparative values for the various end conditions. The following tables, Nos. 22 to 25, are derived partly from experiment on actual columns, extended and completed by comparison with the experiments on rolled struts from which all our previous tables of strut resistances are derived.

Tables Nos. 2 and 4 are taken as the basis for the working values. On account of the more perfect symmetry of form possessed by round and square sections than the shapes for which these tables were especially calculated, the safe loads per square inch of section are increased ten (10) per cent. for round columns, and five (5) per cent. for square columns. That is, the factors of safety previously given remain the same, the ultimate strength is supposed to be 10 and 5 per cent. respectively greater than the rolled struts.

The tables are calculated for certain thicknesses of iron varying from $\frac{1}{8}$ inch for 2-inch diameter up to $\frac{5}{8}$ inch for 12-inch diameter, as marked in the margins. At the same place R represents the radius of gyration for the diameter and thickness given. When the thickness varies but a little from that given, the strength per square inch of section can be accepted as practically unchanged. But when the variation becomes of importance, the radius of gyration corresponding to the altered thickness will have to be obtained, and the strength of the column then ascertained from tables Nos. 2 and 4, as heretofore described.

The following table gives the values of the radius of gyration for round and square columns from 2 to 12 inches diameter, and from $\frac{1}{10}$ of an inch to 1 inch thick.

Example for Round Column:

What is the greatest safe load for a flat-ended round column 6 inches outer diameter, $\frac{1}{2}$ inch thick, 8.64 square inches area, and 18 feet long, $r = 1.95$ $\frac{l}{r} = 111$? By table No. 2 the corresponding safe load = 6,780 lbs. + 10 per cent. = 7,460 lbs. per square inch of section, or 64,440 lbs. for the column.

No. 21.

RADII OF GYRATION FOR ROUND COLUMNS.

Outside Diameter of Column in Inches.	*Thickness in Inches Varying by Tenths.*									
	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
	Corresponding Radius of Gyration in Inches.									
2	.67	.64	.61	.58	.56	.54	.52	.51	.50	.50
3	1.03	.99	.96	.93	.90	.88	.85	.83	.81	.79
4	1.38	1.35	1.31	1.28	1.25	1.22	1.19	1.16	1.14	1.12
5	1.73	1.70	1.66	1.63	1.60	1.57	1.54	1.51	1.48	1.46
6	2.08	2.05	2.02	1.98	1.95	1.92	1.89	1.86	1.83	1.80
7	2.43	2.40	2.36	2.33	2.30	2.27	2.24	2.21	2.18	2.15
8	2.79	2.76	2.72	2.69	2.66	2.62	2.59	2.56	2.53	2.50
9	3.15	3.11	3.08	3.04	3.01	2.97	2.94	2.91	2.88	2.85
10	3.51	3.47	3.44	3.40	3.37	3.33	3.30	3.27	3.23	3.20
11	3.86	3.82	3.79	3.75	3.72	3.68	3.65	3.62	3.58	3.55
12	4.21	4.18	4.15	4.11	4.08	4.04	4.01	3.97	3.94	3.90

RADII OF GYRATION FOR SQUARE COLUMNS.

Outer Diam. Across Flats in Inches.	*Thickness in Inches Varying by Tenths.*									
	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
	Corresponding Radius of Gyration in Inches.									
2	.78	.74	.71	.68	.65	.63	.61	.59	.58	.58
3	1.18	1.14	1.11	1.08	1.04	1.01	.98	.96	.93	.91
4	1.59	1.55	1.51	1.47	1.44	1.41	1.38	1.35	1.32	1.29
5	2.00	1.96	1.92	1.89	1.85	1.81	1.78	1.75	1.71	1.68
6	2.41	2.37	2.33	2.29	2.25	2.21	2.18	2.15	2.11	2.08
7	2.82	2.78	2.74	2.70	2.66	2.62	2.58	2.55	2.51	2.48
8	3.23	3.19	3.15	3.11	3.07	3.03	2.99	2.96	2.92	2.89
9	3.63	3.59	3.55	3.51	3.48	3.44	3.40	3.36	3.32	3.29
10	4.04	4.00	3.96	3.92	3.88	3.84	3.80	3.77	3.73	3.70
11	4.45	4.41	4.37	4.33	4.29	4.25	4.21	4.17	4.13	4.10
12	4.86	4.82	4.78	4.74	4.70	4.66	4.62	4.58	4.54	4.51

IRON COLUMNS.—No. 22.

ROUND SECTION.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION.

By this table for the same ratios of $\frac{l}{r}$ the safe loads are increased 10 per cent. over the results obtained for previous tables, as given in table No. 2.

Size of Outer Diameter.	*Condition of Ends.*	*LENGTH IN FEET.*								
		2	4	6	8	10	12	14	16	18
12 ins.	Fixed.	16000	15800	15660	15220	14330	13350	12640	12040	11470
Diameter.	Flat.	16000	15800	15660	15220	14330	13350	12640	12040	11470
$\frac{5}{8}$″ thick.	Hinged.	16000	15800	15660	14680	13700	12670	12000	11250	10840
$R = 3.94$	Round.	16000	15800	15660	13940	12840	11660	10890	9950	9200
10 ins.	Fixed.	16000	15800	15660	14630	13490	12640	11940	11280	10640
Diameter.	Flat.	16000	15800	15660	14630	13490	12640	11940	11280	10640
$\frac{1}{2}$″ thick.	Hinged.	16000	15800	15160	14030	12810	12000	11140	10450	9750
$R = 3.37$	Round.	16000	15400	14470	13200	11820	10890	9820	8960	8170
8 ins.	Fixed.	16000	15500	14770	13490	12440	11570	10730	9940	9200
Diameter.	Flat.	15800	15300	14770	13490	12440	11570	10730	9940	9200
$\frac{1}{2}$″ thick.	Hinged.	15600	14800	14190	12810	11680	10740	9850	8970	8170
$R = 2.63$	Round.	15600	14600	13380	11820	10480	9330	8280	7330	6460
6 ins.	Fixed.	15400	15220	13490	12140	11000	9940	9050	8440	7860
Diameter.	Flat.	15400	15220	13490	12140	11000	9940	9040	8400	7650
$\frac{3}{8}$″ thick.	Hinged.	15200	14680	12810	11360	10150	8970	7960	7110	6310
$R = 2.00$	Round.	14800	13940	11820	10080	8600	7330	6220	5310	4490
5 ins.	Fixed.	14900	14470	12540	11090	9850	8840	8150	7460	6740
Diameter.	Flat.	14900	14470	12540	11090	9850	8820	8060	7260	6270
$\frac{3}{8}$″ thick.	Hinged.	14400	13870	11790	10250	8880	7660	6710	5920	4920
$R = 1.64$	Round.	14400	13020	10620	8720	7230	5790	4880	4130	3150
4 ins.	Fixed.	14600	13490	11570	9940	8740	7860	7040	6190	5400
Diameter.	Flat.	14600	13490	11570	9940	8710	7650	6560	5640	4680
$\frac{1}{4}$″ thick.	Hinged.	13800	12810	10740	8970	7520	6310	5240	4290	3260
$R = 1.33$	Round.	13200	11820	9330	7330	5750	4490	3460	2580	1880
3 ins.	Fixed.	15220	12140	9940	8440	7330	6190	5110	4130	3300
Diameter.	Flat.	15220	12140	9940	8400	6880	5640	4400	3440	2780
$\frac{3}{16}$″ thick.	Hinged.	14680	11360	8970	7110	5560	4290	2990	2160	1600
$R = 1.00$	Round.	13940	10080	7330	5310	3780	2580	1720	1230	900
2 ins.	Fixed.	13490	9850	7820	6140	4510	3230	2290	1760	1300
Diameter.	Flat.	13490	9850	7590	5580	3770	2720	2000	1400	990
$\frac{1}{8}$″ thick.	Hinged.	12810	8880	6240	4220	2420	1570	1100	790	600
$R = .66$	Round.	11820	7230	4430	2540	1390	890	600	400	300

IRON COLUMNS.—No. 22.

ROUND SECTION.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION.

The calculations are based on the thicknesses and radii of gyration marked under the diameters on marginal columns. See description.

LENGTH IN FEET.									*Condition of Ends.*	*Size of Outer Diameter.*
20	22	24	26	28	30	32	34	36		
10910	10370	9850	9350	8990	8640	8340	8050	7770	Fixed.	**12** ins.
10910	10370	9850	9350	8980	8610	8290	7930	7520	Flat.	Diameter.
10050	9460	8880	8330	7880	7390	6970	6570	6180	Hinged.	$\frac{5}{8}$″ thick.
8490	7850	7230	6640	6030	5610	5150	4750	4370	Round.	$R = 3.94$
10020	9430	8990	8620	8250	7910	7600	7280	6940	Fixed.	**10** ins.
10020	9430	8980	8610	8190	7720	7260	6830	6460	Flat.	Diameter.
9070	8430	7880	7390	6840	6380	5930	5510	5130	Hinged.	$\frac{1}{2}$″ thick.
7430	6740	6030	5610	5010	4560	4130	3730	3350	Round.	$R = 3.37$
8740	8290	7860	7460	7040	6610	6190	5790	5400	Fixed.	**8** ins.
8710	8250	7650	7070	6560	6110	5640	5140	4680	Flat.	Diameter.
7520	6900	6310	5920	5240	4780	4290	3750	3260	Hinged.	$\frac{1}{2}$″ thick.
5750	5090	4490	3960	3460	3000	2580	2210	1880	Round.	$R = 2.66$
7330	6740	6190	5660	5110	4580	4130	3700	3300	Fixed.	**6** ins.
6880	6270	5640	4990	4400	3850	3440	3080	2780	Flat.	Diameter.
5560	4920	4290	3580	2990	2470	2160	1880	1600	Hinged.	$\frac{3}{8}$″ thick.
3780	3150	2580	2090	1720	1440	1230	1040	900	Round.	$R = 2.00$
6100	5440	4760	4210	3670	3160	2790	2400	2100	Fixed.	**5** ins.
5530	4730	4020	3500	3050	2680	2380	2100	1870	Flat.	Diameter.
4160	3310	2640	2220	1850	1540	1300	1100	1000	Hinged.	$\frac{3}{8}$″ thick.
2490	1900	1520	1260	1030	860	750	600	580	Round.	$R = 1.64$
4580	3880	3260	2770	2300	2000	1780	1560	1360	Fixed.	**4** ins.
3850	3210	2750	2370	2000	1740	1470	1220	1010	Flat.	Diameter.
2470	2000	1590	1300	1100	900	800	690	610	Hinged.	$\frac{1}{4}$″ thick.
1440	1100	900	740	600	500	450	380	330	Round.	$R = 1.33$
2650	2100	1790	1500	1240	1070	910	770		Fixed.	**3** ins.
2270	1850	1480	1150	910	710	530	440		Flat.	Diameter.
1250	1000	800	670	560	460	350	280		Hinged.	$\frac{3}{16}$″ thick.
700	580	450	370	290	250	200	170		Round.	$R = 1.00$
1040	800								Fixed.	**2** ins.
680	470								Flat.	Diameter.
400	300								Hinged.	$\frac{1}{8}$″ thick.
200	100								Round.	$R = .66$

STEEL COLUMNS.—No. 23.

ROUND SECTION.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION FOR MEDIUM STEEL.

By this table for the same ratios of $\frac{l}{r}$ the safe loads are increased 10 per cent. over the results obtained for previous tables, as given in table No. 4.

Size of Outer Diameter.	*Condition of Ends.*	*LENGTH IN FEET.*								
		2	4	6	8	10	12	14	16	18
12 ins.	Fixed.	23000	23000	23000	21200	16900	15000	14600	13900	13400
Diameter.	Flat.	23000	23000	23000	21200	16900	15000	14600	13900	13400
$\frac{5}{8}$″ thick.	Hinged.	23000	23000	23000	20500	16300	14300	13700	13000	12400
$R = 3.94$	Round.	23000	23000	23000	19500	15200	13000	12300	11500	10700
10 ins.	Fixed.	23000	23000	23000	18400	15700	14600	13900	13100	12500
Diameter.	Flat.	23000	23000	23000	18400	15700	14600	13900	13100	12500
$\frac{1}{2}$″ thick.	Hinged.	23000	23000	22600	17700	15000	13700	12900	12200	11400
$R = 3.37$	Round.	23000	23000	21600	16600	13700	12300	11300	10400	9700
8 ins.	Fixed.	23000	23000	21000	15700	14400	13300	12900	11900	11000
Diameter.	Flat.	23000	23000	21000	15700	14400	13300	12900	11900	11000
$\frac{1}{2}$″ thick.	Hinged.	23000	23000	18400	13600	12300	12300	11900	10800	9800
$R = 2.66$	Round.	23000	23000	17300	12500	11000	10600	10000	8900	7800
6 ins.	Fixed.	23000	21230	15800	14100	12900	11700	10700	9700	9000
Diameter.	Flat.	23000	21230	15800	14100	12900	11700	10700	9700	8700
$\frac{3}{8}$″ thick.	Hinged.	23000	20500	15000	13100	11900	10600	9400	8200	7200
$R = 2.00$	Round.	23000	19500	13700	11600	10000	8600	7300	6100	5100
5 ins.	Fixed.	23000	16900	14500	13100	11900	10300	9300	8500	7600
Diameter.	Flat.	23000	16900	14500	13100	11900	10300	9200	8100	7000
$\frac{3}{8}$″ thick.	Hinged.	21500	16300	13600	12100	10800	9000	7600	6000	5500
$R = 1.64$	Round.	20500	15200	12200	9400	8900	6900	5600	4500	3500
4 ins.	Fixed.	23000	15700	13500	11700	10200	9000	8000	6800	5900
Diameter.	Flat.	23000	15700	13500	11700	10200	8700	7400	6200	5100
$\frac{1}{4}$″ thick.	Hinged.	21000	15000	12500	10600	8800	7200	5900	4700	3577
$R = 1.33$	Round.	20500	12500	10300	8600	6700	5100	3900	2900	2100
3 ins.	Fixed.	21200	14000	11700	9700	8300	6800	5600	4300	3300
Diameter.	Flat.	21200	14000	11700	9700	7900	6200	4800	3600	2800
$\frac{3}{16}$″ thick.	Hinged.	20500	11900	10600	8200	6300	4700	3300	2200	1600
$R = 1.00$	Round.	19500	11600	8600	6100	4300	2900	1900	1300	900
2 ins.	Fixed.	15700	11600	8900	6800	4800	3200	2300	1800	1300
Diameter.	Flat.	15700	11600	8700	6200	4000	2700	2000	1400	1000
$\frac{1}{8}$″ thick.	Hinged.	15000	10500	7100	4700	2600	1600	1100	900	600
$R = .66$	Round.	13700	8500	5100	2800	1600	900	600	400	300

STEEL COLUMNS.—No. 23.

ROUND SECTION.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION FOR MEDIUM STEEL.

The calculations are based on the thicknesses and radii of gyration marked under the diameters on marginal columns. See description.

LENGTH IN FEET.									*Condition of Ends.*	*Size of Outer Diameter.*
20	22	24	26	28	30	32	34	36		
12800	12200	11600	11000	10600	10100	9600	9200	8900	Fixed.	**12** ins.
12800	12200	11600	11000	10600	10100	9600	9000	8600	Flat.	Diameter.
11800	11100	10500	9800	9300	8800	8100	7500	7100	Hinged.	$\frac{5}{8}$″ thick.
9900	9200	8500	7800	7200	6600	6000	5400	5000	Round.	$R = 3.94$
11800	11000	10600	10200	9400	9000	8800	8300	7700	Fixed.	**10** ins.
11800	11000	10600	10200	9300	8800	8500	7900	7200	Flat.	Diameter.
10600	9800	9300	8800	7800	6600	7000	6300	5700	Hinged.	$\frac{1}{2}$″ thick.
8700	7800	6600	6700	5700	4700	5000	4300	3700	Round.	$R = 3.37$
10200	9400	9000	8500	8000	7400	6800	6400	6100	Fixed.	**8** ins.
10200	9400	8700	8100	7400	6800	6200	5700	5300	Flat.	Diameter.
8800	7800	7200	6600	5900	5300	4700	4600	3700	Hinged.	$\frac{1}{2}$″ thick.
6700	5700	5100	4100	3600	3400	2900	2700	2100	Round.	$R = 2.66$
8300	7600	6800	6200	5600	4900	4300	3800	3300	Fixed.	**6** ins.
7900	7000	6200	5500	4800	4100	3600	3100	2800	Flat.	Diameter.
6300	5500	4700	3900	3300	2600	2200	1900	1600	Hinged.	$\frac{3}{8}$″ thick.
4300	3500	2900	2300	1900	1600	1300	1100	900	Round.	$R = 2.00$
6700	6000	5100	4400	3700	3500	2800	2400	2100	Fixed.	**5** ins.
6100	5200	4300	3600	3100	2700	2400	2100	1900	Flat.	Diameter.
4600	3600	2800	2300	1900	1500	1300	1100	1000	Hinged.	$\frac{3}{8}$″ thick.
2800	2100	1700	1300	1100	900	800	700	600	Round.	$R = 1.64$
4900	4000	3300	2800	2300	2000				Fixed.	**4** ins.
4100	3300	2800	2400	2000	1800				Flat.	Diameter.
2600	2000	1600	1300	1100	900				Hinged.	$\frac{1}{4}$″ thick.
1600	1100	900	800	600	500				Round.	$R = 1.33$
2700	2100	1800	1500						Fixed.	**3** ins.
2300	1900	1500	1200						Flat.	Diameter.
1300	1000	800	700						Hinged.	$\frac{3}{16}$″ thick.
700	600	500	400						Round.	$R = 1.00$
1100	800								Fixed.	**2** ins.
700	500								Flat.	Diameter.
400	300								Hinged.	$\frac{1}{8}$″ thick.
200	100								Round.	$R = .66$

IRON COLUMNS.—No. 24.

SQUARE SECTION.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION.

By this table, for the same ratios of $\frac{l}{r}$, the safe loads are increased 5 per cent. over the results obtained in table No. 2.

Size of Column.	*Condition of Ends.*	*LENGTH IN FEET.*								
		2	4	6	8	10	12	14	16	18
2 ins.	Fixed.	13540	10330	8160	6760	5410	4130	3090	2300	1790
Diameter.	Flat.	13540	10330	8120	6320	4770	3440	2600	2000	1500
$\frac{1}{8}$″ thick.	Hinged.	12940	9500	6920	5060	3420	2180	1500	1100	800
$R = .77$	Round.	12100	8010	5210	3360	2000	1250	850	600	450
3 ins.	Fixed.	14950	12160	10330	8690	7690	6760	5830	4920	4080
Diameter.	Flat.	14950	12160	10330	8680	7570	6320	5280	4240	3410
$\frac{3}{16}$″ thick.	Hinged.	14480	11460	9500	7660	6280	5060	3980	2900	2160
$R = 1.15$	Round.	13810	10400	8010	6020	4540	3360	2380	1680	1240
4 ins.	Fixed.	15270	13540	11690	10330	9010	8150	7420	6720	6040
Diameter.	Flat.	15270	13540	11690	10330	9010	8110	7180	6220	5540
$\frac{1}{4}$″ thick.	Hinged.	14620	12940	10940	9500	8050	6920	5900	5010	4260
$R = 1.53$	Round.	13800	12100	9750	8010	6440	5210	4180	3310	2590
5 ins.	Fixed.	15450	14390	12610	11310	10250	9170	8400	7780	7260
Diameter.	Flat.	15450	14390	12610	11310	10250	9170	8370	7700	6930
$\frac{3}{8}$″ thick.	Hinged.	14800	13860	11950	10540	9410	8220	7260	6400	5660
$R = 1.89$	Round.	14200	13120	10960	9260	7910	6630	5460	4660	3950
6 ins.	Fixed.	15640	14950	13540	12160	11220	10330	9410	8690	8160
Diameter.	Flat.	15640	14950	13540	12160	11220	10330	9410	8680	8120
$\frac{3}{8}$″ thick.	Hinged.	15100	14480	12940	11460	10450	9500	8480	7660	6920
$R = 2.30$	Round.	14700	13820	12100	10390	9150	8010	6910	6020	5210
8 ins.	Fixed.	15990	15260	14670	13540	12480	11690	10950	10250	9650
Diameter.	Flat.	15990	15260	14670	13540	12480	11690	10950	10250	9650
$\frac{1}{2}$″ thick.	Hinged.	15300	14800	17170	12940	11800	10940	10160	9410	8750
$R = 3.07$	Round.	15100	14200	13440	12100	10800	9750	8790	8010	7190
10 ins.	Fixed.	16000	15260	14570	14380	13540	12750	12060	11400	10860
Diameter.	Flat.	16000	15260	14570	14380	13540	12750	12060	11400	10860
$\frac{1}{2}$″ thick.	Hinged.	16000	15260	14170	13860	12940	12090	11360	10640	10070
$R = 3.87$	Round.	16000	15100	14170	13120	12100	11130	10270	9380	8670
12 ins.	Fixed.	16000	15600	15150	14950	14250	13420	12750	12140	11690
Diameter.	Flat.	16000	15600	15150	14950	14250	13420	12750	12140	11690
$\frac{5}{8}$″ thick.	Hinged.	16000	15300	14650	14480	13700	12800	12090	11460	10940
$R = 4.55$	Round.	16000	15100	14250	13820	12950	11930	11130	10400	9750

IRON COLUMNS.—No. 24.

SQUARE SECTION.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION.

The calculations are based on the thicknesses and radii of gyration marked under the diameters in marginal columns. See previous description.

LENGTH IN FEET.									Condition of Ends.	Size of Column.
20	22	24	26	28	30	32	34	36		
1440	1120	930	760						Fixed.	**2** ins.
1100	810	580	430						Flat.	Diameter.
640	490	380	270						Hinged.	$\frac{1}{8}''$ thick.
360	260	210	170						Round.	$R = .77$
3380	2770	2290	1900	1660	1430	1210	1060	910	Fixed.	**3** ins.
2800	2360	2000	1670	1370	1090	880	710	560	Flat.	Diameter.
1690	1300	1090	900	750	630	550	450	370	Hinged.	$\frac{3}{16}''$ thick.
900	700	600	500	400	360	290	240	210	Round.	$R = 1.15$
5370	4670	4080	3540	3020	2650	2250	1960	1770	Fixed.	**4** ins.
4710	3980	3410	2940	2560	2270	1980	1700	1500	Flat.	Diameter.
3370	2630	2160	1800	1470	1260	1080	900	800	Hinged.	$\frac{1}{4}''$ thick.
1950	1530	1200	1000	830	700	600	500	400	Round.	$R = 1.53$
6670	6130	5580	5020	4500	4020	3570	3150	2790	Fixed.	**5** ins.
6230	5650	4970	4340	3800	3350	2900	2660	2370	Flat.	Diameter.
4960	4370	3630	2990	2480	2120	1800	1540	1330	Hinged.	$\frac{3}{8}''$ thick.
3460	2680	2140	1720	1440	1210	1000	870	760	Round.	$R = 1.89$
7690	7210	6760	6310	5830	5410	4920	4500	4080	Fixed.	**6** ins.
7570	6880	6320	5840	5280	4770	4240	3800	3410	Flat.	Diameter.
6280	5610	5060	4570	3980	3420	2900	2480	2160	Hinged.	$\frac{3}{8}''$ thick.
4540	3900	3360	2870	2380	2000	1800	1440	1240	Round.	$R = 2.30$
9010	8550	8160	7820	7470	7130	6760	6390	6040	Fixed.	**8** ins.
9010	8530	8120	7760	7250	6750	6320	5930	5540	Flat.	Diameter.
8050	7450	6920	6470	5960	5480	5060	4660	4260	Hinged.	$\frac{1}{2}''$ thick.
6430	5690	5210	4730	4230	3780	3360	2960	2590	Round.	$R = 3.07$
10330	9820	9320	8790	8490	8200	7920	7640	7340	Fixed.	**10** ins.
10330	9820	9320	8790	8470	8170	7870	7500	7060	Flat.	Diameter.
9500	8940	8400	7800	7390	6980	6590	6220	5780	Hinged.	$\frac{1}{2}''$ thick.
8010	7390	6810	6170	5620	5280	4860	4480	4060	Round.	$R = 3.87$
11130	10680	10250	9730	9320	8920	8640	8350	8110	Fixed.	**12** ins.
11130	10680	10250	9730	9320	8920	8630	8320	8060	Flat.	Diameter.
10350	9880	9410	8840	8400	7960	7600	7180	6860	Hinged.	$\frac{5}{8}''$ thick.
9030	8440	7910	7300	6810	6340	5940	5490	5130	Round.	$R = 4.55$

STEEL COLUMNS.—No. 25.

SQUARE SECTION.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION FOR MEDIUM STEEL.

By this table, for the same ratios of $\frac{l}{r}$, the safe loads are increased 5 per cent. over the results obtained in table No. 4.

Size of Column.	*Condition of Ends.*	*LENGTH IN FEET.*								
		2	4	6	8	10	12	14	16	18
2 ins.	Fixed.	16000	12100	9400	7700	6000	4300	3100	2300	1800
Diameter.	Flat.	16000	12100	9400	7200	5300	3600	2600	2000	1500
$\frac{1}{8}$″ thick.	Hinged.	15300	11100	8000	5700	3800	2300	1500	1100	800
$R = .77$	Round.	14300	9400	6000	3800	2200	1300	900	600	500
3 ins.	Fixed.	22300	14000	12100	10300	8800	7700	6400	5400	4300
Diameter.	Flat.	22300	14000	12100	10300	8600	7200	5800	4600	3600
$\frac{3}{16}$″ thick.	Hinged.	22300	13200	11100	9100	7200	5700	4400	3000	2300
$R = 1.15$	Round.	21300	11900	9400	7100	5200	3700	2600	1800	1300
4 ins.	Fixed.	23000	16000	13500	12000	10500	9400	8500	7700	6700
Diameter.	Flat.	23000	16000	13500	12000	10500	9400	8200	7200	6100
$\frac{1}{4}$″ thick.	Hinged.	22700	15300	13100	11000	9300	8000	6700	5700	4700
$R = 1.53$	Round.	21700	14300	11800	9200	7400	6000	4800	3800	2900
5 ins.	Fixed.	23000	18900	14400	13100	12000	10500	9800	9100	8300
Diameter.	Flat.	23000	18900	14400	13100	12000	10500	9800	8800	7900
$\frac{3}{8}$″ thick.	Hinged.	23000	18200	13500	11900	11000	9300	8500	7300	6500
$R = 1.89$	Round.	23000	17200	12400	10700	9200	7400	6500	5300	4400
6 ins.	Fixed.	23000	22300	16000	14000	13000	12000	11100	10300	9400
Diameter.	Flat.	23000	22300	16000	14000	13000	12000	11100	10300	9400
$\frac{3}{8}$″ thick.	Hinged.	23000	22300	15300	13200	12100	11000	10000	9100	8000
$R = 2.30$	Round.	23000	21300	14300	11900	10600	9200	8100	7100	6000
8 ins.	Fixed.	23000	23000	20900	16000	14400	13500	12800	12000	11300
Diameter.	Flat.	23000	23000	20900	16000	14400	13500	12800	12000	11300
$\frac{1}{2}$″ thick.	Hinged.	23000	22700	20200	15300	13700	12600	11800	11000	10200
$R = 3.07$	Round.	23000	21700	19300	14300	12400	11200	10200	9200	8300
10 ins.	Fixed.	23000	23000	23000	19600	16000	14800	13900	13200	12700
Diameter.	Flat.	23000	23000	23000	19600	16000	14800	13900	13200	12700
$\frac{1}{2}$″ thick.	Hinged.	23000	23000	22300	18900	15300	13800	13100	12300	11700
$R = 3.87$	Round.	23000	22100	21300	17900	13600	12300	11200	10800	10100
12 ins.	Fixed.	23000	23000	23000	22300	18900	15800	14800	14000	13500
Diameter.	Flat.	23000	23000	23000	22300	18900	15800	14800	14000	13500
$\frac{5}{8}$″ thick.	Hinged.	23000	22300	22300	21600	18200	15100	14100	13200	12600
$R = 4.55$	Round.	23000	22300	21700	20600	17200	14000	12900	11900	11200

STEEL COLUMNS.—No. 25.

SQUARE SECTION.

GREATEST SAFE LOADS IN POUNDS PER SQUARE INCH OF SECTION FOR MEDIUM STEEL.

The calculations are based on the thicknesses and radii of gyration marked under the diameters in marginal columns. See previous description.

LENGTH IN FEET.									*Condition of Ends.*	*Size of Column.*
20	22	24	26	28	30	32	34	36		
									Fixed.	**2** ins.
									Flat.	Diameter.
									Hinged.	$\frac{1}{8}$″ thick.
									Round.	$R = .77$
3400	2800	2300	1900	1700					Fixed.	**3** ins.
2800	2400	2000	1700	1400					Flat.	Diameter.
1700	1300	1100	900	700					Hinged.	$\frac{3}{16}$″ thick.
900	700	600	500	400					Round.	$R = 1.15$
5900	5100	4200	3800	3000	2700	2300	2000	1800	Fixed.	**4** ins.
4900	4100	3500	3100	2600	2300	2000	1700	1500	Flat.	Diameter.
3500	2900	2200	1900	1500	1300	1100	900	800	Hinged.	$\frac{1}{4}$″ thick.
2000	1700	1200	1100	800	700	600	500	400	Round.	$R = 1.53$
7500	6700	6200	5500	4800	4200	3600	3200	2800	Fixed.	**5** ins.
7000	6200	5500	4700	4000	3600	2900	2700	2500	Flat.	Diameter.
5600	4800	4000	3300	2600	2200	1800	1600	1500	Hinged.	$\frac{3}{8}$″ thick.
3700	2900	2400	1900	1500	1300	1000	900	800	Round.	$R = 1.89$
8800	8200	7700	7000	6400	5900	5400	4800	4300	Fixed.	**6** ins.
8600	7800	7200	6500	5800	5200	4600	4100	3600	Flat.	Diameter.
7200	6400	5700	5000	4400	3700	3200	2700	2300	Hinged.	$\frac{3}{8}$″ thick.
5200	4400	3800	3200	2600	2148	1800	1600	1300	Round.	$R = 2.30$
10700	10000	9400	8900	8500	8100	7800	7200	6900	Fixed.	**8** ins.
10700	10000	9400	8800	8300	7700	7400	6600	6100	Flat.	Diameter.
9500	8800	8000	7300	6800	6300	5900	4200	4700	Hinged.	$\frac{1}{2}$″ thick.
7600	6500	6000	5300	4800	4300	4000	3300	2900	Round.	$R = 3.07$
12100	11500	11000	10400	10000	9500	9100	8700	8400	Fixed.	**10** ins.
12100	11500	11000	10400	10000	9500	9000	8500	8100	Flat.	Diameter.
11200	10500	9900	9200	8300	8100	7500	7400	6600	Hinged.	$\frac{1}{2}$″ thick.
9800	8700	8000	7300	6400	6114	5600	5000	3400	Round.	$R = 3.87$
12900	12500	12000	11400	11000	10600	10200	9700	9400	Fixed.	**12** ins.
12900	12500	12000	11400	11000	10600	10200	9700	9300	Flat.	Diameter.
12000	11500	11000	10400	9900	9400	9000	8400	7900	Hinged.	$\frac{5}{8}$″ thick.
10400	9800	9200	8600	7700	7500	7000	6400	5900	Round.	$R = 4.55$

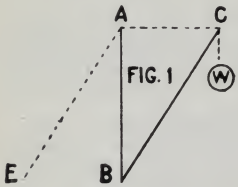
STRESSES IN SOME SIMPLE FORMS OF FRAMED STRUCTURES.

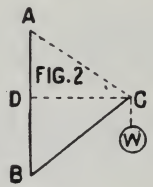
Compression indicated by the sign — and by solid lines. Tension by the sign + and by dotted lines.

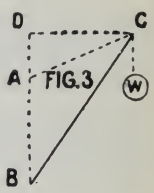
When the prefix "stress" is used, the load borne by the member is indicated; otherwise the length of the member is meant.

Cranes.

Supported at the points A and B, maximum longitudinal stresses, due to weight W, suspended at the end. These stresses are modified by the position of the hoisting chain.







D is the point where a line drawn from C at right angles to $A\ B$ will intersect the latter.

$$\text{Stress } A\ C = + \frac{A\ C}{A\ B} \times W \qquad \text{Stress } B\ C = \frac{B\ C}{A\ B} \times W$$

$$\text{“ } A\ B = - \frac{A\ D}{A\ B} \times W \text{ in Fig. 2, or} = + \frac{A\ D}{A\ B} \times W \text{ in Fig. 3.}$$

When point A is supported by inclined back stays as shown in Fig. 1, and when the back stay is in the plane of $A\ B$ and W.

$$\text{Stress } A\ E = + \frac{A\ C}{A\ B} \times W \times \frac{A\ E}{E\ B},$$

and a resulting compression ensues on

$$A\ B = - \frac{A\ C}{A\ B} \times W \times \frac{A\ B}{B\ E}.$$

Cranes.

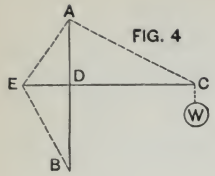


FIG. 4

$$\text{Stress } C\,D = -\frac{C\,D}{A\,D} \times W$$

$$\text{“ } A\,C = +\frac{A\,C}{A\,D} \times W$$

$$\text{“ } E\,D = -\text{ stress } D\,C.$$

Let w = the horizontal reaction at B

$$w = \frac{C\,D}{A\,B} \times W$$

$$\text{Stress } B\,E = +\frac{B\,E}{E\,D} \times w$$

$$\text{“ } A\,E = +\frac{A\,E}{D\,E} \times (\text{stress } C\,D - w)$$

$$\text{“ } B\,A = -\left(\frac{B\,D}{D\,E} \times w + W\right)$$

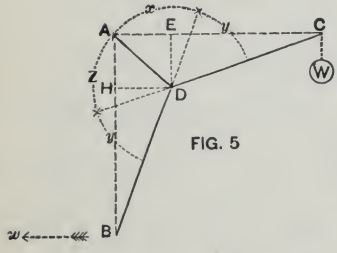


FIG. 5

E and H are points where lines drawn from D intersect at right angles $A\,C$ and $A\,B$. X, Y and Z are the angles formed by extending the braces $C\,D$ and $B\,D$ as indicated by dotted lines. w = the horizontal reaction at B

$$w = \frac{A\,C}{A\,B} \times W.$$

$$\text{Stress } A\,C = +\frac{C\,E}{E\,D} \times W. \qquad \text{Stress } C\,D = -\frac{C\,D}{E\,D} \times W$$

$$\text{“ } A\,B = +\frac{B\,H}{D\,H} \times w. \qquad \text{“ } B\,D = -\frac{B\,D}{H\,D} \times w$$

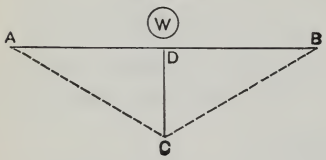
$$A\,D = -\text{ stress } C\,D \times \frac{\text{Sine } Y}{\text{Sine } X}$$

$$\text{or} = -\text{ stress } B\,D \times \frac{\text{Sine } Y}{\text{Sine } Z}$$

Trussed Girders.

Weight in Middle.

FIG. 6



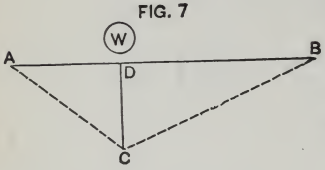
Stress $A\ C$ or $B\ C = + \frac{A\ C}{D\ C} \times \frac{W}{2}$

" $A\ B = - \frac{A\ D}{D\ C} \times \frac{W}{2}$

" $D\ C = - W$

Weight out of Centre.

FIG. 7



Stress $A\ C = + \frac{A\ C \times D\ B}{A\ B \times D\ C} \times W$

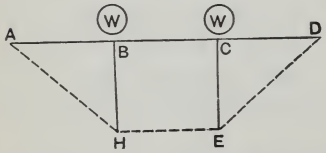
" $B\ C = + \frac{B\ C \times A\ D}{A\ B \times C\ D} \times W$

Stress $A\ B = - \frac{A\ D \times D\ B}{A\ B \times D\ C} \times W$

" $D\ C = - W$

Equal Loads W. W.

FIG. 8



Stress $A\ H$ or $D\ E = + \frac{A\ H}{B\ H} \times W$

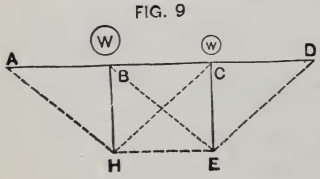
" $H\ E = + \frac{A\ B}{B\ H} \times W$

" $A\ D = - \frac{A\ B}{B\ H} \times W$

Stress $B\ H$ or $C\ E = - W$

Unequal Loads W and w.

FIG. 9

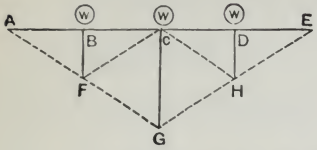


Stress as below on counter diagonals $B\ E$ or $H\ C$ according to position of greatest load.

Stress $C\ H = + \frac{C\ H}{B\ H} \times \left(\frac{W - w}{3} \right)$

Fink Truss.

FIG. 10



Stress $B\,F$ or $D\,H = -\,W$

" $C\,G = -\,2\,W$

" $A\,E = -\,1\tfrac{1}{2}\,W \times \dfrac{A\,C}{C\,G}$

Stress $A\,F$ or $H\,E = +\,1\tfrac{1}{2}\,W \times \dfrac{A\,F}{F\,B}$

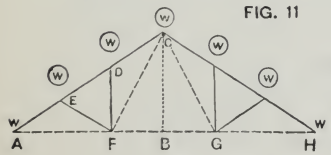
" $F\,G$ or $H\,G = +\,W \times \dfrac{A\,G}{C\,G}$

$F\,C$ or $C\,H = +\,\dfrac{W}{2} \times \dfrac{A\,G}{C\,G}$

ROOFS.

w = load concentrated on each triangular apex.

FIG. 11



Strut Stresses.

Stress $D\,F = -\,w$

" $E\,F = \dfrac{w}{2} \times \dfrac{C\,H}{C\,B}$

Stresses on Ties.

Stress $F\,G = +\,1\tfrac{1}{2}\,w \times \dfrac{B\,H}{B\,C}$

" $A\,F = +\,2\tfrac{1}{2}\,w \times \dfrac{B\,H}{B\,C}$

" $C\,F = +\,1\tfrac{1}{2}\,w \times \dfrac{C\,G}{B\,C}$

Rafter Stresses.

Stress $C\,E = -\,2\,w \times \dfrac{C\,H}{C\,B}$

" $E\,A = -\,2\tfrac{1}{2}\,w \times \dfrac{C\,H}{C\,B}$

Roofs.

w = load concentrated on each triangular apex.

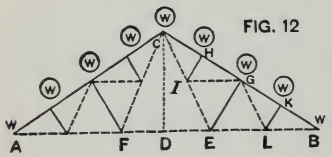


FIG. 12

Strut Stresses.

Stress HI or $KL = -w \times \frac{DB}{CB}$

" $GE = -2w \times \frac{DB}{CB}$

Rafter Stresses.

Stress $KB = -\left(\frac{7w}{2} \times \frac{CB}{CD}\right)$

" $GK = -\left(\frac{7w}{2} \times \frac{CB}{CD} - w \times \frac{CD}{CB}\right)$

" $HG = -\left(\frac{7w}{2} \times \frac{CB}{CD} - 2w \times \frac{CD}{CB}\right)$

" $CH = -\left(\frac{7w}{2} \times \frac{CB}{CD} - 3w \times \frac{CD}{CB}\right)$

Stresses on Ties.

Stress GI or $GL = +\frac{w}{2} \times \frac{DB}{CB} \times \frac{CB}{CD}$

" $EI = +w \times \frac{DB}{CB} \times \frac{CB}{CD}$

" $CI = +\frac{3w}{2} \times \frac{DB}{CB} \times \frac{CB}{CD}$

" $FE = +\frac{8w}{4} \times \frac{DB}{DC}$

" EL = the sum of the stresses on FE and EI.

" LB = the sum of the stresses on EL and GL.

Roofs.

w = load concentrated on each triangular apex.

The rafters and horizontal tie being each uniformly subdivided.

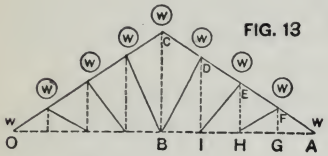


FIG. 13

Strut Stresses.

Stress $FH = -\frac{w}{2} \times \frac{FH}{FG}$

" $EI = -w \times \frac{EI}{EH}$

" $DB = -\frac{3w}{2} \times \frac{DB}{DI}$

Vertical Ties.

Stress $EH = +\frac{w}{2}$. Stress $DI = +w$. Stress $CB = +3w$.

Rafter Stresses.

Stress $CD = -2 \ w \times \frac{CA}{CB}$

" $DE = -2\frac{1}{2} \ w \times \frac{CA}{CB}$

" $EF = -3 \ w \times \frac{CA}{CB}$

" $FA = -3\frac{1}{2} \ w \times \frac{CA}{CB}$

Horizontal Tie.

Stress at $B = +2w \times \frac{BA}{BC}$

" $BI = +$ stress at $B + \left(\text{stress } DB \times \frac{BI}{BD}\right)$

" $IH = +$ " $BI + \left(\text{" } EI \times \frac{HI}{EI}\right)$

" $HA = +$ " $IH + \left(\text{" } FH \times \frac{HG}{HF}\right)$

SHAFTING OF WROUGHT IRON OR STEEL.

The resistance to shearing averages about $\frac{8}{10}$ of the tensile strength, *i. e.*, about 40,000 lbs. for wrought iron, or 50,000 lbs. for soft steel, per square inch of section. The torsional resistance of any shaft can be determined when the shearing resistance is known; thus

$$T = .196\ d^3 s \text{ for round shafts,} \qquad (a)$$

$$T = .28\ d^3 s \text{ for square shafts.} \qquad (b)$$

d = diameter of the shaft in inches.

s = shearing strength in pounds per square inch.

T = the torsional moment in inch-pounds; that is, the force in pounds multiplied by the length in inches of the lever through which the force acts.

Taking s at 40,000 and 50,000 lbs., respectively for iron and steel, and assuming that in machinery the working value should be between one-fourth and one-fifth of the ultimate strength—adopting the mean—makes the working resistance to shearing 9,000 lbs. per square inch for iron, and 11,200 lbs. per square inch for steel. Putting this in terms of the torsional moment and diameter, we derive from equations a and b

$$T = 1760\ d^3 \text{ for round iron shafts,} \qquad (c)$$

$$T = 2200\ d^3 \text{ for round steel shafts,} \qquad (d)$$

$$T = 2520\ d^3 \text{ for square iron shafts,} \qquad (e)$$

$$T = 3150\ d^3 \text{ for square steel shafts,} \qquad (f)$$

$$d = \sqrt[3]{\frac{T}{1760}} \text{ for round iron shafts,} \qquad (g)$$

$$d = \sqrt[3]{\frac{T}{2200}} \text{ for round steel shafts,} \qquad (h)$$

$$d = \sqrt[3]{\frac{T}{2520}} \text{ for square iron shafts,} \qquad (i)$$

$$d = \sqrt[3]{\frac{T}{3150}} \text{ for square steel shafts,} \qquad (k)$$

Example 1.—What should be the diameter of a round wrought-iron shaft to safely resist a force of 1,000 lbs. acting through a lever 30 inches long?

$$(g) \qquad d = \sqrt[3]{\frac{1000 \times 30}{1760}} = 2.6 \text{ inches in diameter.}$$

These formulæ apply to shafts subject to twisting strains alone. In practice, however, such cases seldom occur, as shafts are generally subjected to combined bending and twisting strains. As there are no experimental data for such a combination of forces, we have to rely on analysis, which gives the following:

$$T^1 = M + \sqrt{M^2 + T^2} \qquad (l)$$

M = bending moments in inch-pounds. (See page 126.)
T = twisting " "
T^1 = a *new* twisting moment which, substituted for T in equations g to k, will give the desired proportions for the shaft.

In revolving shafts the longitudinal stress resulting from the bending action is continually changing from tension to compression, and vice versa.

It is therefore advisable, for reasons given on page 39, to increase the factor of safety as the bending stress increases comparatively to the torsional stress.

The following changes in factors of safety are recommended:

Ratio of M to T.	*Factor of Safety.*	*Divisor in Formulæ.*	
		(g) for Iron.	*(h) for Steel.*
$M = .3T$ or less,	$4\frac{1}{2}$	1760	2200
$M = .6T$ "	5	1570	1960
$M = T$ "	$5\frac{1}{2}$	1430	1790
$M =$ greater than T,	6	1310	1640

Example 2.—What should be the diameter of the journals of a wrought-iron shaft of a steam engine, the piston being

12 inches diameter, crank 12 inches long, and the leverage from centre of crank to journal in the direction of the shaft being 6 inches, steam pressure 80 lbs. per square inch, making pressure on crank = 9,050 lbs.?

$$T = 9{,}050 \times 12 = 108{,}600 \text{ inch-lbs.}$$

$$M = 9{,}050 \times 6 = 54{,}300 \quad \text{“}$$

(*l*) $T^1 = 54{,}300 + \sqrt{54{,}300^2 + 108{,}600^2} = 175{,}720$ inch-lbs.

Substituting the above in equation (*g*), with the factor of safety as explained above,

$$d = \sqrt[3]{\frac{175{,}720}{1{,}570}} = 4.82 \text{ inches diameter.}$$

The following illustrates a case where the bending moment is greater than the twisting moment:

Example 3.—A non-continuous shaft is so located that it must have its bearings 84 inches apart, and carry in the middle a 60-inch pulley driven by a 12-inch belt, the effective weight at centre of shaft = 600 lbs., and the belt exercises a vertical pull of 1,000 lbs. What is the proper diameter of the shaft?

$$M = \frac{(1{,}000 + 600) \times 84}{4} = 33{,}600 \text{ inch-lbs.}$$ (see page 126).

$$T = 1{,}000 \times 30 = 30{,}000 \text{ inch-lbs.}$$

(*l*) $T^1 = 33{,}600 + \sqrt{33{,}600^2 + 30{,}000^2} = 78{,}640$ inch-lbs.

As M is greater than T, use a factor of safety of 6, which becomes by equation (*g*)

$$d = \sqrt[3]{\frac{78{,}640}{1{,}310}} = 4.12 \text{ inches diameter.}$$

If above shaft was continuous and uniformly loaded, the bending moment would be less. (See Table of Bending Moments, page 128.)

HORSE-POWER.

If it is desired to find the relations between horse-power and diameters of shafts, the elements of time and velocity have to be considered. Taking the horse-power *HP* at 396,000 inch-lbs. per minute, we have $HP = \frac{6.28 \times T \times V}{396{,}000}$, where V = revolutions per minute.

$$T = \frac{63{,}057\ HP}{V}, \qquad (m)$$

or in terms of the diameter by equation (*c*) we get for iron shafts

$$d = \sqrt[3]{\frac{36\ HP}{V}}. \qquad (o)$$

The above will give the proper diameter of a shaft for transmitting any desired *HP* when the shaft is subjected to twisting stress alone; but since, as previously stated, such a case seldom occurs, we must combine the bending and twisting stresses, for which a general rule will be given at the close of the subject.

DEFLECTION OF SHAFTING.

As the deflection of steel and iron is practically alike under similar conditions of dimensions and loads, and as shafting is usually determined by its transverse stiffness rather than its ultimate strength, it follows that nearly the same dimensions should be used for steel that are found necessary for iron.

For continuous line shafting used for transmitting power in shops, factories, etc., it is considered good practice to limit the deflection to a maximum of $\frac{1}{100}$ of an inch per foot of length. The weight of bare shafting in pounds $= 2.6\ d^2 l = W$, or when as fully loaded with pulleys as is customary in practice, and allowing 40 lbs. per inch of width for the vertical pull of the belts, experience shows the load in pounds to be about $13\ d^2 l = W$. Taking the modulus of transverse elasticity at 26,000,000 lbs., we can derive from the authoritative formulæ the following:

$$l = \sqrt[3]{873 d^2} \text{ for bare shafts,} \qquad (p)$$

$$l = \sqrt[3]{175 d^2} \text{ for shafts carrying pulleys, etc.,} \qquad (r)$$

which would be the maximum distance in feet between bearings for continuous shafting subjected to bending stress alone.

If the length is fixed, and we desire the diameter of the shaft, we have,

$$d = \sqrt{\frac{l^3}{873}} \text{ for bare shafting.} \qquad (s)$$

$$d = \sqrt{\frac{l^3}{175}} \text{ for shafting carrying pulleys, etc.} \qquad (t)$$

To apply the above to revolving shafting subjected to both twisting and bending stress, it is necessary to combine equations (p) and (r) with equation (o).

But in shafting, with the same transmission of power, the torsional stress is inversely proportional to the velocity of rotation, while the bending stress will not be reduced in the same ratio. It is, therefore, impossible to write a formula covering the whole problem and sufficiently simple for practical application, but the following rules are correct within the range of velocities usual in practice.

WORKING FORMULÆ FOR CONTINUOUS SHAFTING.

For the diameter (d) in inches, and the maximum length (l) in feet between bearings of steel or iron shafting so proportioned as to deflect not more than $\frac{1}{100}$ of an inch per foot of length, allowance being made for the weakening effect of key seats,

$$d = \sqrt[3]{\frac{50\ HP}{V}} \text{ for bare shafts,} \qquad (u)$$

$$d = \sqrt[3]{\frac{70\ HP}{V}} \text{ for shafts carrying pulleys, etc.,} \qquad (v)$$

$$l = \sqrt[3]{720 d^2} \text{ for bare shafts,} \qquad (w)$$

$$l = \sqrt[3]{140 d^2} \text{ for shafts carrying pulleys, etc.,} \qquad (x)$$

In the event of the whole power being received on a principal shaft, the proper size of the shaft can be estimated direct by formula (*l*).

Example 4.—A principal shaft receiving 150 *HP* from the engine, revolves 150 R. P. M., and is continuous over bearings located 6 feet apart, the centre of main pulley being 24 inches from one bearing and 48 inches from the other. The effective load at the centre of the pulley resulting from weight of pulley and shaft, and tension of belt, is 1,500 lbs. What should be the diameter of the shaft?

Note.—Excepting special cases which rarely occur in practice, it is best to treat such shafts as non-continuous.

By Fig. 5, page 127 we have

$$M = \frac{1{,}500 \times 24 \times 48}{72} = 24{,}000 \text{ inch-lbs.},$$

and by formula (*m*) we have

$$T = \frac{63{,}000 \times 150}{150} = 63{,}000 \text{ inch-lbs.},$$

then by formula (*l*) we have

$$T^1 = 24{,}000 + \sqrt{24{,}000^2 + 63{,}000^2} = 92{,}290 \text{ inch-lbs.},$$

and by formula (*g*)

$$d = \sqrt[3]{\frac{92{,}290}{1{,}760}} = 3.74 \text{ inches.}$$

The moment of resistance of round shafts for bending is one-half of the resistance for twisting strains.

The resistances are simply and accurately expressed thus:

$$M = \frac{AD}{8} \text{ and } T = \frac{AD}{4} \text{ for solid shafts.}$$

$$M = \frac{AD^2 - ad^2}{8D} \text{ and } T = \frac{AD^2 - ad^2}{4D} \text{ for hollow shafts.}$$

D being full diameter and A corresponding area, d is internal diameter and a corresponding area.

BELTING.

When designing shafting, allow for the tension of belting, 50 lbs. per inch of width for single leather belt or its equivalent, or 80 lbs. per inch of width for double leather belt, or its equivalent of other material.

WORKING PROPORTIONS FOR CONTINUOUS SHAFTING.

IRON OR STEEL.

Transmitting power, but subject to no bending action except its own weight.

Diameter of Shaft in Inches.	*Maximum Safe Torsional Moment in Inch-Pounds.*	*Revolutions per Minute.*					*Maximum Distance in Feet Between Bearings.*
		100	150	200	250	300	
		HP	*HP*	*HP*	*HP*	*HP*	
1 1/2	5940	7	10	14	17	20	11.7
1 5/8	7552	9	13	17	21	26	12.4
1 3/4	9432	11	16	21	26	32	13.0
1 7/8	11602	13	20	26	33	40	13.6
2	14080	16	24	32	40	48	14.2
2 1/8	16892	19	29	38	48	58	14.8
2 1/4	20048	23	34	46	57	68	15.4
2 3/8	23580	27	40	54	67	80	16.0
2 1/2	27500	31	47	63	78	94	16.5
2 3/4	36603	42	62	83	102	124	17.6
3	47520	54	81	108	134	162	18.6
3 1/4	60417	69	103	137	172	206	19.7
3 1/2	75460	86	129	172	215	258	20.7
3 3/4	92812	105	158	211	264	316	21.6
4	112640	128	192	256	320	384	22.6

WORKING PROPORTIONS FOR CONTINUOUS SHAFTING.

IRON OR STEEL.

Transmitting power, and subject to bending action of pulleys, belting, etc.

Diameter of Shaft in Inches.	*Maximum Safe Torsional Moment in Inch-Pounds.*	*Revolutions per Minute.*					*Maximum Distance in Feet Between Bearings.*
		100	150	200	250	300	
		HP	*HP*	*HP*	*HP*	*HP*	
1½	5940	5	7	10	12	14	6.8
1⅝	7552	6	9	12	15	18	7.2
1¾	9432	8	11	15	18	22	7.5
1⅞	11602	9	14	19	23	28	7.9
2	14080	11	17	23	28	34	8.2
2⅛	16892	14	21	27	34	42	8.6
2¼	20048	16	24	33	41	48	8.9
2⅜	23580	19	29	38	48	58	9.2
2½	27500	22	33	45	55	66	9.6
2¾	36603	24	36	48	60	72	10.2
3	47520	39	58	77	96	116	10.8
3¼	60417	49	74	98	123	148	11.4
3½	75460	61	92	123	153	184	12.0
3¾	92812	75	113	151	188	226	12.5
4	112640	91	137	183	228	274	13.1

MAXIMUM BENDING MOMENTS ON PINS,

With Extreme Fibre Strains

Varying from 15,000 to 25,000 Pounds per Square Inch.

Diameter of Pin in Inches.	*Area of Pin in Sq. Inches.*	*Moments in Inch-Pounds for Fibre Strains of*				
		15,000 *lbs. per Sq. Inch.*	18,000 *lbs. per Sq. Inch.*	20,000 *lbs. per Sq. Inch.*	22,500 *lbs. per Sq. Inch.*	25,000 *lbs. per Sq. Inch.*
1	0.785	1470	1770	1960	2210	2450
1 1/8	0.994	2100	2520	2800	3140	3500
1 1/4	1.227	2880	3450	3830	4310	4790
1 3/8	1.485	3830	4590	5100	5740	6380
1 1/2	1.767	4970	5960	6630	7460	8280
1 5/8	2.074	6320	7580	8430	9480	10500
1 3/4	2.405	7890	9470	10500	11800	13200
1 7/8	2.761	9710	11600	12900	14600	16200
2	3.142	11800	14100	15700	17700	19600
2 1/8	3.547	14100	17000	18800	21200	23600
2 1/4	3.976	16800	20100	22400	25200	28000
2 3/8	4.430	19700	23700	26300	29600	32900
2 1/2	4.909	23000	27600	30700	34500	38400
2 5/8	5.412	26600	32000	35500	40000	44400
2 3/4	5.940	30600	36800	40800	45900	51000
2 7/8	6.492	35000	42000	46700	52500	58300
3	7.069	39800	47700	53000	59600	66300
3 1/8	7.670	44900	53900	59900	67400	74900
3 1/4	8.296	50600	60700	67400	75800	84300
3 3/8	8.946	56600	67900	75500	84900	94400
3 1/2	9.621	63100	75800	84200	94700	105200
3 5/8	10.321	70100	84200	93500	105200	116900
3 3/4	11.045	77700	93200	103500	116500	129400
3 7/8	11.793	85700	102800	114200	128500	142800
4	12.566	94200	113100	125700	141400	157100
4 1/8	13.364	103400	124000	137800	155000	172300
4 1/4	14.186	113000	135700	150700	169600	188400
4 3/8	15.033	123300	148000	164400	185000	205500
4 1/2	15.904	134200	161000	178900	201300	223700
4 5/8	16.800	145700	174800	194300	218500	242800
4 3/4	17.721	157800	189400	210400	236700	263000
4 7/8	18.665	170600	204700	227500	255900	284400
5	19.635	184100	220900	245400	276100	306800
5 1/8	20.629	198200	237900	264300	297300	330400
5 1/4	21.648	213100	255700	284100	319600	355200
5 3/8	22.691	228700	274400	304900	343000	381100
5 1/2	23.758	245000	294000	326700	367500	408300
5 5/8	24.850	262100	314500	349500	393100	436800
5 3/4	25.967	280000	335900	373300	419900	466600
5 7/8	27.109	298600	358300	398200	447900	497700

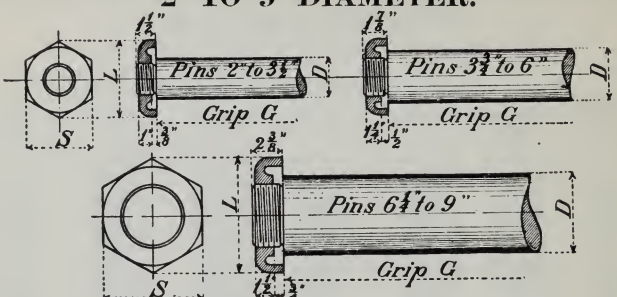
MAXIMUM BENDING MOMENTS ON PINS,

With Extreme Fibre Strains

Varying from 15,000 to 25,000 Pounds per Square Inch.

Diameter of Pin in Inches.	*Area of Pin in Sq. Inches.*	*Moments in Inch-Pounds for Fibre Strains of*				
		15,000 *lbs. per Sq. Inch.*	18,000 *lbs. per Sq. Inch.*	20,000 *lbs. per Sq. Inch.*	22,500 *lbs. per Sq. Inch.*	25,000 *lbs. per Sq. Inch.*
6	28.274	318100	381700	424100	477100	530200
6 1/8	29.465	338400	406100	451200	507600	564000
6 1/4	30.680	359500	431400	479400	539300	599200
6 3/8	31.919	381500	457800	508700	572300	635900
6 1/2	33.183	404400	485300	539200	606600	674000
6 5/8	34.472	428200	513800	570900	642300	713700
6 3/4	35.785	452900	543500	603900	679400	754800
6 7/8	37.122	478500	574200	638000	717800	797500
7	38.485	505100	606100	673500	757700	841900
7 1/8	39.871	532700	639200	710200	799000	887800
7 1/4	41.282	561200	673400	748200	841800	935300
7 3/8	42.718	590700	708900	787600	886100	984500
7 1/2	44.179	621300	745500	828400	931900	1035400
7 5/8	45.664	652900	783400	870500	979300	1088100
7 3/4	47.173	685500	822600	914000	1028200	1142500
7 7/8	48.707	719200	863000	958900	1078800	1198700
8	50.265	754000	904800	1005300	1131000	1256600
8 1/8	51.849	789900	947900	1053200	1184800	1316500
8 1/4	53.456	826900	992300	1102500	1240300	1378200
8 3/8	55.088	865100	1038100	1153400	1297600	1441800
8 1/2	56.745	904400	1085200	1205800	1356600	1507300
8 5/8	58.426	944900	1133800	1259800	1417300	1574800
8 3/4	60.132	986500	1183800	1315400	1479800	1644200
8 7/8	61.862	1029400	1235300	1372500	1544100	1715700
9	63.617	1073500	1288200	1431400	1610300	1789200
9 1/8	65.397	1118900	1342700	1491900	1678400	1864800
9 1/4	67.201	1165500	1398600	1554000	1748300	1942500
9 3/8	69.029	1213400	1456100	1617900	1820100	2022300
9 1/2	70.882	1262600	1515100	1683400	1893900	2104300
9 5/8	72.760	1313100	1575700	1750800	1969600	2188500
9 3/4	74.662	1364900	1637900	1819900	2047400	2274900
9 7/8	76.590	1418100	1701700	1890800	2127100	2363500
10	78.54	1472600	1767100	1963500	2208900	2454400
10 1/4	82.52	1585900	1903000	2114500	2378800	2643100
10 1/2	86.59	1704700	2045700	2273000	2557100	2841200
10 3/4	90.76	1829400	2195300	2439300	2744200	3049100
11	95.03	1960100	2352100	2613400	2940100	3266800
11 1/4	99.40	2096800	2516100	2795700	3145200	3494800
11 1/2	103.87	2239700	2687600	2986300	3359500	3732800
12	113.10	2544700	3053600	3392900	3817000	4241200

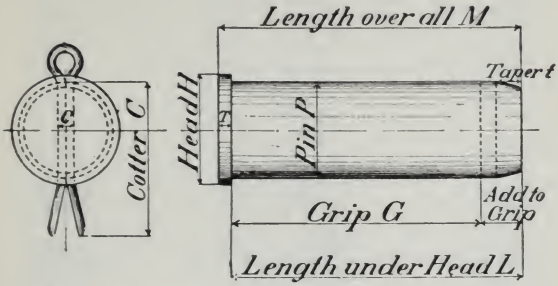
STANDARD PINS AND NUTS FROM 2″ TO 9″ DIAMETER.



	PIN.						NUT.					WASHER.			D.
	Diameter of Pin.		Diameter of Pin Hole.	Play in Pin Hole.	Screw. Diameter.	Screw. Length.	Size of Rough Hole.	Short Diameter. S.	Long Diameter. L.	Weight of Nut.	Additional Amt. Added for Grip.	Diameter.	Thickness.	Hole.	Nominal Diameter.
Lateral Pins.	2	2.00	2.030	0.030	1½	1½	1 5/16	3 1/4	3 3/4	1 1/4	1/4	4 1/4	3/8	2 1/8	1 15/16
	2 1/4	2.25	2.280	0.030	1½	1½	1 5/16	3 1/4	3 3/4	1 1/4	1/4	4 1/4	3/8	2 3/8	2 3/16
	2 1/2	2.50	2.530	0.030	2	1½	1 13/16	3 3/4	4 5/16	2	1/4	4 3/4	3/8	2 3/8	2 7/16
	2 3/4	2.75	2.780	0.030	2	1½	1 13/16	3 3/4	4 5/16	2	1/4	5	3/8	2 7/8	2 11/16
	3	3.00	3.030	0.030	2½	1½	2 5/16	4 1/2	5 3/16	2 1/2	1/4	5 3/4	3/8	3 1/8	2 15/16
	3 1/4	3.25	3.280	0.030	2½	1½	2 5/16	4 1/2	5 3/16	2 1/2	1/4	5 3/4	3/8	3 3/8	3 3/16
	3 1/2	3.50	3.530	0.030	2½	1½	2 5/16	4 1/2	5 3/16	2 1/2	1/4	6 1/8	3/8	3 3/8	3 7/16
Truss Pins.	3 3/4	3.75	3.771	0.021	3	1 7/8	2 13/16	5	5 3/4	3 1/4	1/2	6 1/2	1/2	3 7/8	3 11/16
	4	4.00	4.022	0.022	3	1 7/8	2 13/16	5	5 3/4	3 1/4	1/2	6 3/4	1/2	4 1/8	3 15/16
	4 1/4	4.25	4.273	0.023	3½	1 7/8	3 5/16	5 3/4	6 5/8	4 1/2	1/2	7 1/4	1/2	4 3/8	4 3/16
	4 1/2	4.50	4.524	0.024	3½	1 7/8	3 5/16	5 3/4	6 5/8	4 1/2	1/2	7 3/8	1/2	4 5/8	4 7/16
	4 3/4	4.75	4.775	0.025	3½	1 7/8	3 5/16	5 3/4	6 5/8	4 1/2	1/2	7 3/4	1/2	4 7/8	4 11/16
	5	5.00	5.026	0.026	4	1 7/8	3 13/16	6 1/2	7 1/2	6	1/2	8	1/2	5 1/8	4 15/16
	5 1/4	5.25	5.277	0.027	4	1 7/8	3 13/16	6 1/2	7 1/2	6	1/2	8 3/8	1/2	5 1/8	5 3/16
	5 1/2	5.50	5.528	0.028	4 1/2	1 7/8	4 5/16	7	8 1/8	7 1/2	1/2	8 3/4	1/2	5 3/8	5 7/16
	5 3/4	5.75	5.779	0.029	4 1/2	1 7/8	4 5/16	7	8 1/8	7 1/2	1/2	9 1/8	1/2	5 7/8	5 11/16
	6	6.00	6.030	0.030	4 1/2	1 7/8	4 5/16	7	8 1/8	7 1/2	1/2	9 1/2	1/2	6 1/8	5 15/16
	6 1/4	6.25	6.28	0.030	5	2 3/8	4 13/16	7 3/4	8 15/16		3/4	9 7/8	5/8	6 3/8	6 3/16
	6 1/2	6.50	6.53	0.030	5	2 3/8	4 13/16	7 3/4	8 15/16		3/4	10 1/4	5/8	6 3/8	6 7/16
	6 3/4	6.75	6.78	0.030	5 1/2	2 3/8	5 5/16	8 1/4	9 1/2		3/4	10 5/8	5/8	6 7/8	6 11/16
	7	7.00	7.03	0.030	5 1/2	2 3/8	5 5/16	8 1/4	9 1/2		3/4	10 7/8	5/8	7 1/8	6 15/16
	7 1/4	7.25	7.28	0.030	6	2 3/8	5 13/16	9	10 3/8		3/4	11 1/8	5/8	7 3/8	7 3/16
	7 1/2	7.50	7.53	0.030	6	2 3/8	5 13/16	9	10 3/8		3/4	11 1/2	5/8	7 5/8	7 7/16
	7 3/4	7.75	7.78	0.030	6 1/2	2 3/8	6 5/16	9 1/2	11		3/4	11 7/8	5/8	7 7/8	7 11/16
	8	8.00	8.03	0.030	6 1/2	2 3/8	6 5/16	9 1/2	11		3/4	12 1/4	5/8	8 1/8	7 15/16
	8 1/4	8.25	8.28	0.030	7	2 3/8	6 13/16	10 1/4	11 13/16		3/4	12 5/8	5/8	8 3/8	8 3/16
	8 1/2	8.50	8.53	0.030	7	2 3/8	6 13/16	10 1/4	11 13/16		3/4	13 1/4	5/8	8 5/8	8 7/16
	8 3/4	8.75	8.78	0.030	7 1/2	2 3/8	7 5/16	11	12 11/16		3/4	13 5/8	5/8	8 7/8	8 11/16
	9	9.00	9.03	0.030	7 1/2	2 3/8	7 5/16	11	12 11/16		3/4	14	5/8	9 1/8	8 15/16

NOTE.—To obtain grip *G* of pin, add 1/16 extra for each bar packed together with the proper additional amount given above in the table.

STANDARD COTTER PINS FROM 1″ TO 3¾″ DIAMETER.



Diameter of Pin.		Diameter of Pin Hole.	Play in Pin Hole.	Diameter of Head H.	Thickness of Head T.	Taper at End t.	Length L under Head equal to.	Length M over all equal to.	Size of Cotter C.	Diameter of Pin P.
1	1.00	1.03	0.03	1 1/4	1/4	5/16 x 1/16	G + 5/8	G + 7/8	1/4 x 1 3/4	1
1 1/4	1.25	1.28	0.03	1 1/2	1/4	5/16 x 1/16	G + 5/8	G + 7/8	1/4 x 2	1 1/4
1 1/2	1.50	1.53	0.03	1 3/4	1/4	7/16 x 3/32	G + 3/4	G + 1	5/16 x 2 1/2	1 1/2
1 3/4	1.75	1.78	0.03	2	1/4	7/16 x 3/32	G + 3/4	G + 1	5/16 x 2 3/4	1 3/4
2	2.00	2.03	0.03	2 3/8	3/8	1/2 x 1/8	G + 7/8	G + 1 1/4	3/8 x 3	2
2 1/4	2.25	2.28	0.03	2 5/8	3/8	1/2 x 1/8	G + 7/8	G + 1 1/4	3/8 x 3 1/4	2 1/4
2 1/2	2.50	2.58	0.03	2 7/8	3/8	5/8 x 5/32	G + 1 1/8	G + 1 1/2	7/16 x 3 3/4	2 1/2
2 3/4	2.75	2.78	0.03	3 1/8	3/8	5/8 x 5/32	G + 1 1/8	G + 1 1/2	7/16 x 4	2 3/4
3	3.00	3.03	0.03	3 1/2	1/2	3/4 x 3/16	G + 1 3/8	G + 1 7/8	1/2 x 5	3
3 1/4	3.25	3.28	0.03	3 3/4	1/2	3/4 x 3/16	G + 1 3/8	G + 1 7/8	1/2 x 5	3 1/4
3 1/2	3.50	3.53	0.03	4	1/2	7/8 x 7/32	G + 1 5/8	G + 2 1/8	5/8 x 6	3 1/2
3 3/4	3.75	3.78	0.03	4 1/4	1/2	7/8 x 7/32	G + 1 5/8	G + 2 1/8	5/8 x 6	3 3/4

SHEARING AND BEARING VALUE OF RIVETS IN POUNDS.

GENERAL SPECIFICATIONS.

All dimensions in inches.

Diameter of Rivet. Inches. Fraction.	Decimal.	*Area in Square Inches.*	*Single Shear at 6,000 Lbs.*	*Bearing Value for Different Thicknesses of Plate in Inches, at 12,000 Pounds per Square Inch.*											
				1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
3/8	.375	.1104	660	1130	1410	1690										
1/2	.500	.1963	1180	1500	1880	2250	2630	3000								
5/8	.625	.3068	1840	1880	2340	2810	3280	3750	4220	4690						
3/4	.750	.4418	2650	2250	2810	3380	3940	4500	5160	5630	6190	6750				
7/8	.875	.6013	3610	2630	3280	3940	4590	5250	5910	6560	7220	7880	8530	9190	9840	
1	1.000	.7854	4710	3000	3750	4500	5250	6000	6750	7500	8250	9000	9750	10500	11250	12000

Diameter of Rivet. Inches. Fraction.	Decimal.	*Area in Square Inches.*	*Single Shear at 7,500 Pounds.*	*Bearing Value for Different Thicknesses of Plate in Inches, at 15,000 Pounds per Square Inch.*											
				1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
3/8	.375	.1104	830	1410	1760	2110										
1/2	.500	.1963	1470	1880	2340	2810	3280	3750								
5/8	.625	.3068	2300	2340	2930	3520	4100	4690	5280	5860						
3/4	.750	.4418	3310	2810	3520	4220	4920	5630	6330	7030	7720	8440				
7/8	.875	.6013	4510	3280	4100	4920	5740	6560	7380	8200	9030	9850	10670	11480	12300	
1	1.000	.7854	5890	3750	4690	5620	6560	7500	8440	9380	10310	11250	12190	13130	14060	15000

In above tables all bearing values above or to right of upper zigzag lines are greater than double shear.
Values between upper and lower zigzag lines are less than double and greater than single shear.
Values below and to left of lower zigzag lines are less than single shear.

SHEARING AND BEARING VALUE OF RIVETS IN POUNDS.

PENCOYD SPECIFICATIONS.

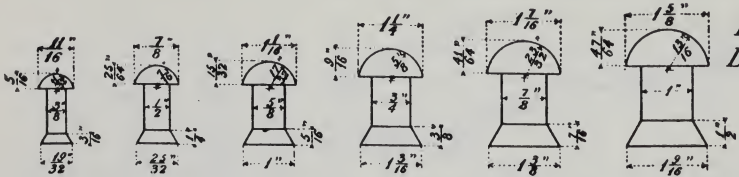
All dimensions in inches.

Diameter of Rivet. Inches. Fraction.	Diameter of Rivet. Inches. Decimal.	Area in Square Inches.	Single Shear at 10,000 Lbs.	Bearing Value for Different Thicknesses of Plate in Inches, at 20,000 Pounds per Square Inch.												
				$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
$\frac{3}{8}$	.375	.1104	1100	1880	2340	2810										
$\frac{1}{2}$	.500	.1963	1960	2500	3130	3750	4380	5000								
$\frac{5}{8}$	.625	.3068	3070	3130	3910	4690	5470	6250	7030	7810						
$\frac{3}{4}$	.750	.4418	4420	3750	4690	5630	6560	7500	8440	9380	10310	11250				
$\frac{7}{8}$	.875	.6013	6010	4380	5470	6570	7660	8750	9840	10940	12030	13130	14220	15310	16410	
1	1.000	.7854	7850	5000	6250	7500	8750	10000	11250	12500	13750	15000	16250	17500	18750	20000

Diameter of Rivet. Inches. Fraction.	Diameter of Rivet. Inches. Decimal.	Area in Square Inches.	Single Shear at 12,000 Pounds.	Bearing Value for Different Thicknesses of Plate in Inches, at 25,000 Pounds per Square Inch.												
				$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$	1
$\frac{3}{8}$	.375	.1104	1320	2350	2930	3520										
$\frac{1}{2}$	.500	.1963	2360	3130	3910	4690	5470	6250								
$\frac{5}{8}$	.625	.3068	3680	3910	4880	5860	6840	7810	8790	9770						
$\frac{3}{4}$	.750	.4418	5300	4690	5860	7030	8210	9380	10550	11720	12890	14060				
$\frac{7}{8}$	.875	.6013	7220	5470	6840	8210	9580	10940	12310	13670	15040	16410	17770	19140	20510	
1	1.000	.7854	9430	6250	7820	9380	10940	12500	14060	15630	17190	18750	20320	21880	23440	25000

In above tables all bearing values above or to right of upper zigzag lines are greater than double shear.
Values between upper and lower zigzag lines are less than double and greater than single shear.
Values below and to left of lower zigzag lines are less than single shear.

PENCOYD RIVET PROPORTIONS.



Finished Heads

Diam. Head = 1½ Diam. of Shank + ⅛"

Depth of Head = 4/10 Diam. of Head

Countersunk

Depth of Head = ½ Diam. of Shank

Bevel of Head = 60 Degrees.

PENCOYD RIVET SIGNS.

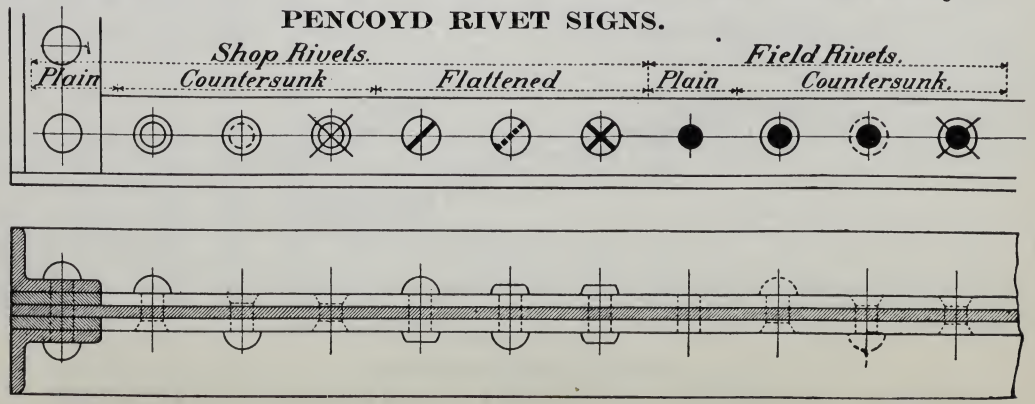
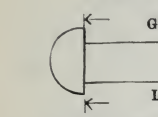
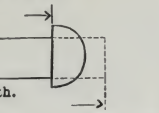


TABLE SHOWING LENGTH OF RIVET-SHANK REQUIRED TO FORM HEAD.

PLAIN RIVETS.



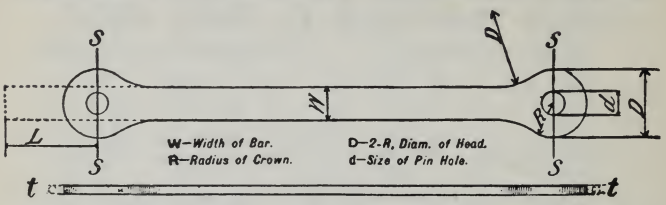
COUNTERSUNK RIVETS.



Grip in Inches.	Diameter in Inches.					Grip in Inches.	Diameter in Inches.					Grip in Inches.
	½	⅝	¾	⅞	1		½	⅝	¾	⅞	1	
	Length in Inches.						Length in Inches.					
1/2	1 1/2	1 3/4	1 7/8	2	2 1/8	1/2	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1/2
5/8	1 5/8	1 7/8	2	2 1/8	2 1/4	5/8	1 1/4	1 3/8	1 3/8	1 1/2	1 1/2	5/8
3/4	1 3/4	2	2 1/8	2 1/4	2 3/8	3/4	1 3/8	1 1/2	1 1/2	1 5/8	1 5/8	3/4
7/8	1 7/8	2 1/8	2 1/4	2 3/8	2 1/2	7/8	1 1/2	1 5/8	1 5/8	1 3/4	1 3/4	7/8
1	2	2 1/4	2 3/8	2 1/2	2 5/8	1	1 5/8	1 3/4	1 3/4	1 7/8	1 7/8	1
1 1/8	2 1/8	2 3/8	2 1/2	2 5/8	2 3/4	1 1/8	1 3/4	1 7/8	1 7/8	2	2	1 1/8
1 1/4	2 1/4	2 1/2	2 5/8	2 3/4	2 7/8	1 1/4	1 7/8	2	2	2 1/8	2 1/8	1 1/4
1 3/8	2 3/8	2 5/8	2 3/4	2 7/8	3	1 3/8	2	2 1/8	2 1/8	2 1/4	2 1/4	1 3/8
1 1/2	2 5/8	2 7/8	3	3 1/8	3 1/4	1 1/2	2 1/8	2 1/4	2 3/8	2 3/8	2 1/2	1 1/2
1 5/8	2 3/4	3	3 1/8	3 1/4	3 3/8	1 5/8	2 1/4	2 3/8	2 1/2	2 1/2	2 5/8	1 5/8
1 3/4	2 7/8	3 1/8	3 1/4	3 3/8	3 1/2	1 3/4	2 3/8	2 1/2	2 5/8	2 5/8	2 3/4	1 3/4
1 7/8	3	3 1/4	3 3/8	3 1/2	3 5/8	1 7/8	2 1/2	2 5/8	2 3/4	2 3/4	2 7/8	1 7/8
2	3 1/8	3 3/8	3 1/2	3 5/8	3 3/4	2	2 5/8	2 3/4	2 7/8	2 7/8	3	2
2 1/8	3 1/4	3 1/2	3 5/8	3 3/4	3 7/8	2 1/8	2 3/4	2 7/8	3	3	3 1/8	2 1/8
2 1/4	3 3/8	3 5/8	3 3/4	3 7/8	4	2 1/4	2 7/8	3	3 1/8	3 1/8	3 1/4	2 1/4
2 3/8	3 1/2	3 3/4	3 7/8	4	4 1/8	2 3/8	3	3 1/8	3 1/4	3 1/4	3 3/8	2 3/8
2 1/2	3 5/8	3 7/8	4	4 1/8	4 1/4	2 1/2	3 1/8	3 1/4	3 3/8	3 3/8	3 1/2	2 1/2
2 5/8	3 3/4	4	4 1/8	4 1/4	4 3/8	2 5/8	3 1/4	3 3/8	3 1/2	3 1/2	3 5/8	2 5/8
2 3/4	3 7/8	4 1/8	4 1/4	4 3/8	4 1/2	2 3/4	3 3/8	3 1/2	3 5/8	3 5/8	3 3/4	2 3/4
2 7/8	4	4 1/4	4 3/8	4 1/2	4 5/8	2 7/8	3 1/2	3 5/8	3 3/4	3 3/4	3 7/8	2 7/8
3	4 1/4	4 1/2	4 5/8	4 3/4	4 7/8	3	3 3/4	3 3/4	3 7/8	4	4 1/8	3
3 1/8	4 3/8	4 5/8	4 3/4	4 7/8	5	3 1/8	3 7/8	3 7/8	4	4 1/8	4 1/4	3 1/8
3 1/4	4 1/2	4 3/4	4 7/8	5	5 1/8	3 1/4	4	4 1/8	4 1/8	4 1/4	4 3/8	3 1/4
3 3/8	4 5/8	4 7/8	5	5 1/8	5 1/4	3 3/8	4 1/8	4 1/4	4 1/4	4 3/8	4 1/2	3 3/8
3 1/2	4 3/4	5	5 1/8	5 1/4	5 3/8	3 1/2	4 1/4	4 3/8	4 3/8	4 1/2	4 5/8	3 1/2
3 5/8	4 7/8	5 1/8	5 1/4	5 3/8	5 1/2	3 5/8	4 3/8	4 1/2	4 1/2	4 5/8	4 3/4	3 5/8
3 3/4	5	5 1/4	5 3/8	5 1/2	5 5/8	3 3/4	4 1/2	4 5/8	4 5/8	4 3/4	4 7/8	3 3/4
3 7/8	5 1/8	5 3/8	5 1/2	5 5/8	5 3/4	3 7/8	4 5/8	4 3/4	4 3/4	4 7/8	5	3 7/8
4	5 1/4	5 1/2	5 5/8	5 3/4	5 7/8	4	4 3/4	4 7/8	5	5	5 1/8	4
4 1/8	5 3/8	5 5/8	5 3/4	5 7/8	6	4 1/8	4 7/8	5	5 1/8	5 1/8	5 1/4	4 1/8
4 1/4	5 1/2	5 3/4	5 7/8	6	6 1/8	4 1/4	5	5 1/8	5 1/4	5 1/4	5 3/8	4 1/4
4 3/8	5 5/8	5 7/8	6	6 1/8	6 1/4	4 3/8	5 1/8	5 1/4	5 3/8	5 3/8	5 1/2	4 3/8
4 1/2	5 7/8	6 1/8	6 1/4	6 3/8	6 1/2	4 1/2				5 1/2	5 5/8	4 1/2
4 5/8	6	6 1/4	6 3/8	6 1/2	6 5/8	4 5/8				5 5/8	5 3/4	4 5/8
4 3/4	6 1/8	6 3/8	6 1/2	6 5/8	6 3/4	4 3/4				5 3/4	5 7/8	4 3/4
4 7/8	6 1/4	6 1/2	6 5/8	6 3/4	6 7/8	4 7/8				5 7/8	6	4 7/8
5	6 3/8	6 5/8	6 3/4	6 7/8	7	5					6	5
5 1/8	6 1/2	6 5/8	6 7/8	7	7 1/8	5 1/8					6 1/8	5 1/8
5 1/4	6 5/8	6 7/8	7	7 1/8	7 1/4	5 1/4					6 1/4	5 1/4
Heads	5.7	10.9	13.4	22.2	38.0							

For weight of rivets, see page 245.

TABLE OF STANDARD STEEL EYE BARS.



W. *Width of Bar.* *Inches.*	*t.* *Minimum Thickness of Bar.* *Inches.*	*D.* *Diameter of Head.* *Inches.*	*d.* *Diameter of Largest Pin Hole.* *Inches.*	*L.* *Additional Length of Bar Beyond Centre of Eye Required to Form One Head.* *Inches.*
3	3/4	7	3	15
3	3/4	8	3 7/8	17 1/2
4	3/4	9 1/2	4 1/8	18
4	3/4	10 1/2	5 1/16	20 1/2
5	3/4	11 1/2	4 13/16	19 1/2
5	3/4	12 1/2	5 11/16	23 1/4
5	3/4	13	6 3/16	26 1/2
6	7/8	13 1/2	5 1/2	23
6	7/8	14 1/2	6 5/16	26 1/4
7	1 5/16	16	6 11/16	26 3/4
7	1 5/16	17	7 1/2	30 1/4
7	1 5/16	18	8 1/2	36 3/4
8	1	17	6 3/8	26 3/4
8	1	18	7 3/8	30
8	1	18 1/2	7 7/8	33 3/4

NOTE.—To all bars up to 6 inches wide and 1 inch thick and under, add 1½ inches extra for each eye to the length of the bar. To all bars up to 7 and 8 inches wide and 1⅜ inches thick and under, add 1½ inches extra for each eye to the length of the bar.

NOTE.—Pencoyd Standard Eye Bars are Hydraulic Forged, and are guaranteed to develop the value of the bar, under conditions given in the above table, when tested to destruction. The maximum sizes of pin holes as given in the above table, allow an excess in sectional area of head on line *SS* over that of the body of the bar of 33 per cent. for diameters of pins, not larger than the width of the bar, and 36 per cent. for pins of larger diameter than width of bar; the thickness of eye being the same as the thickness of the body of the bar.

NOTE.—The steel manufactured by us for the use of eye bars is open-hearth steel, and will be furnished of such quality as to satisfy the demands of engineers.

NOTE.—All eye bars are finished to length according to measurements to U. S. Standard as made by G. M. Eddy & Co.

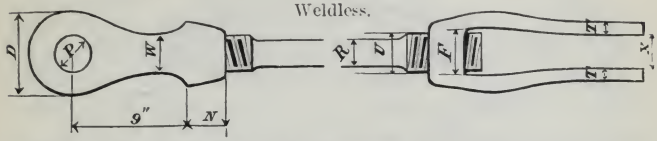
PENCOYD CLEVISES.

PROPORTIONED FOR STRAINS PER SQUARE INCH.

TENSION, 10,000 LBS. BEARING, 12,000 LBS. BENDING, 15,000 LBS.

SHEARING, 6,250 LBS. EYE SECTION = 1¾ ROD.

Weldless.



Distance *X* can be made to suit connection.—All dimensions in inches.

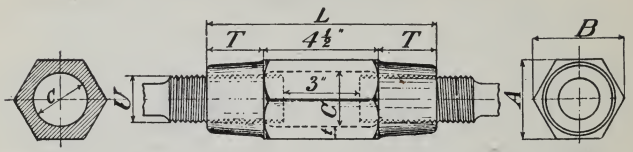
Number of Clevis.	Square Rod. R.	Upset. U.	Pin. P.	Diameter. D.	Nut. N.	Width. W.	Thickness. T.	Fork. F.	Weight in Pounds.
1	1	1½	2½	4½	2	2	⅝	2	12½
1	1⅛	1⅝	2½	4½	2	2	⅝	2	11½
1	1¼	1⅞	2¼	4½	2	2	⅝	2	11½
2	1⅛	1⅝	2¾	5	2¼	2¼	⅝	2¼	15
2	1¼	1⅞	2½	5	2¼	2¼	⅝	2¼	14
2	1⅜	2	2¼	5	2¼	2¼	⅝	2¼	14
3	1⅜	2	3	5½	2½	2½	¾	2½	19½
3	1½	2¼	2¾	5½	2½	2½	¾	2½	19½
3	1⅝	2⅜	2¼	5½	2½	2½	¾	2½	20
4	1½	2¼	3¼	6	2¾	2¾	¾	2¾	25½
4	1⅝	2⅜	2¾	6	2¾	2¾	¾	2¾	26
4	1¾	2½	2½	6	2¾	2¾	¾	2¾	26
5	1⅝	2⅜	3¾	6½	3	3	⅞	3	28
5	1¾	2½	3¼	6½	3	3	⅞	3	29
5	1⅞	2¾	3	6½	3	3	⅞	3	29
6	1¾	2½	3¾	7	3¼	3¼	⅞	3¼	37
6	1⅞	2¾	3¼	7	3¼	3¼	⅞	3¼	37
6	2	2⅞	3	7	3¼	3¼	⅞	3¼	37
7	2	2⅞	4	7½	3½	3½	1	3½	43
7	2⅛	3	3½	7½	3½	3½	1	3½	44
7	2¼	3¼	3	7½	3½	3½	1	3½	45

Pencoyd clevises are proportioned for a range of three rods to each clevis. The sizes of pins given are the maximum allowed according to size of rod and strength of clevis.

Rods smaller than the minimum size given can still be used for each clevis and the size of pin can be correspondingly increased.

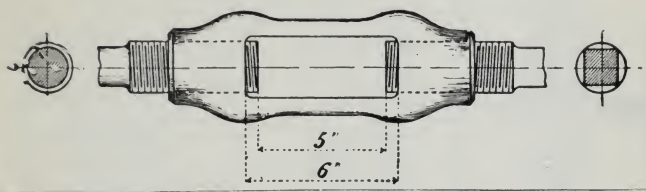
STANDARD SLEEVE NUTS.

U. S. Standard Thread.



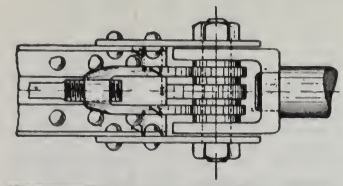
Round Bars.		*Square Bars.*		*Size of Upset.*	*Length of Thread.*	*Length of Nut.*	*Short Diam. Nut.*	*Long Diam. Nut.*	*Inside Diam. Nut.*	*Thickness.*	*Weight of One Sleeve Nut.*
Diam.	*Area.*	*Side.*	*Area.*	*U.*	*T.*	*L.*	*A.*	*B.*	*C.*	*t.*	
5/8	0.307			7/8 x 4	1 1/4	7	1 5/8	1 7/8	1 1/8	1/4	
3/4	0.442			1 x 4	1 1/4	7	1 5/8	1 7/8	1 1/8	1/4	
		3/4	0.563	1 1/8 x 4	1 1/2	7 1/2	2	2 5/16	1 3/8	5/16	
7/8	0.601	7/8	0.766	1 1/4 x 4	1 1/2	7 1/2	2	2 5/16	1 3/8	5/16	
1	0.785			1 3/8 x 4	1 3/4	8	2 3/8	2 3/4	1 5/8	3/8	
1 1/8	0.994	1	1.000	1 1/2 x 4	1 3/4	8	2 3/8	2 3/4	1 5/8	3/8	
1 1/4	1.227	1 1/8	1.266	1 5/8 x 4 1/2	2	8 1/2	2 3/4	3 3/16	1 7/8	7/16	
1 3/8	1.485			1 3/4 x 4 1/2	2	8 1/2	2 3/4	3 3/16	1 7/8	7/16	
		1 1/4	1.563	1 7/8 x 4 1/2	2 1/4	9	3 1/8	3 5/8	2 1/8	1/2	
1 1/2	1.767	1 3/8	1.891	2 x 5	2 1/4	9	3 1/8	3 5/8	2 1/8	1/2	
1 5/8	2.074			2 1/8 x 5	2 1/2	9 1/2	3 1/2	4 1/16	2 3/8	9/16	
1 3/4	2.405	1 1/2	2.250	2 1/4 x 5	2 1/2	9 1/2	3 1/2	4 1/16	2 3/8	9/16	
1 7/8	2.761	1 5/8	2.641	2 3/8 x 5 1/2	2 3/4	10	3 7/8	4 1/2	2 5/8	5/8	
2	3.142	1 3/4	3.063	2 1/2 x 5 1/2	2 3/4	10	3 7/8	4 1/2	2 5/8	5/8	
2 1/8	3.547			2 5/8 x 5 1/2	3	10 1/2	4 1/4	4 1 5/16	2 7/8	1 1/16	
		1 7/8	3.516	2 3/4 x 6	3	10 1/2	4 1/4	4 1 5/16	2 7/8	1 1/16	
2 1/4	3.976	2	4.000	2 7/8 x 6	3 1/4	11	4 5/8	5 3/8	3 1/8	3/4	
2 3/8	4.430	2 1/8	4.516	3 x 6	3 1/4	11	4 5/8	5 3/8	3 1/8	3/4	
2 1/2	4.909			3 1/8 x 6 1/2	3 1/2	11 1/2	5	5 1 3/16	3 3/8	1 3/16	
2 5/8	5.412	2 1/4	5.063	3 1/4 x 6 1/2	3 1/2	11 1/2	5	5 1 3/16	3 3/8	1 3/16	
2 3/4	5.940			3 3/8 x 7	3 3/4	12	5 3/8	6 1/8	3 5/8	7/8	
		2 3/8	5.641	3 1/2 x 7	3 3/4	12	5 3/8	6 1/8	3 5/8	7/8	
2 7/8	6.492	2 1/2	6.250	3 5/8 x 8	4	12 1/2	5 3/4	6 11/16	3 7/8	1 5/16	
3	7.069			3 3/4 x 8	4	12 1/2	5 3/4	6 11/16	3 7/8	1 5/16	
3 1/8	7.670	2 5/8	6.891	3 7/8 x 8	4 1/4	13	6 1/8	7 1/8	4 1/8	1	
3 1/4	8.296	2 3/4	7.563	4 x 8	4 1/4	13	6 1/8	7 1/8	4 1/8	1	

ALLOWANCE FOR UPSETS ON SQUARE AND ROUND BARS.



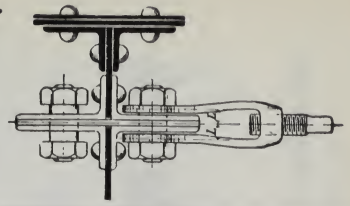
Round Bars.					Size of Upset.						Square Bars.				
Diameter.	Area Square Inches.	Weight per Lineal Foot.	Add for Upset.	Excess of Area @ Root of Thread.	Diameter.	Length.	Diameter at Root of Thread.	Area at Root of Thread.	Number of Threads per Inch.	Weight of One Turnbuckle.	Side of Square.	Area Square Inches.	Weight per Lineal Foot.	Add for Upset.	Excess of Area @ Root of Thread.
Ins.		Lbs.	Ins.	%	Ins.	Ins.	Ins.	Sq. Ins.		Lbs.	Ins.		Lbs.	Ins.	%
5/8	0.307	1.023	4 1/2	36.8	7/8	4	0.731	0.420	9	2 1/2					
3/4	0.442	1.473	3 7/8	24.4	1	4	0.837	0.550	8	3 1/2					
					1 1/8	4	0.940	0.694	7	4	3/4	0.563	1.875	3 1/2	20.6
7/8	0.601	2.004	5	48.3	1 1/4	4	1.065	0.891	7	5 1/4	7/8	0.766	2.552	4	16.3
1	0.785	2.618	4 3/8	34.7	1 3/8	4	1.160	1.057	6	6					
1 1/8	0.994	3.313	3 7/8	30.3	1 1/2	4	1.284	1.295	6	7 1/2	1	1.000	3.333	4	29.5
1 1/4	1.227	4.091	3 7/8	23.5	1 5/8	4 1/2	1.389	1.515	5 1/2	8 1/2	1 1/8	1.266	4.219	4 1/2	19.7
1 3/8	1.485	4.950	3 1/2	17.4	1 3/4	4 1/2	1.490	1.744	5	10					
					1 7/8	4 1/2	1.615	2.049	5	11 1/2	1 1/4	1.563	5.208	4 1/2	31.1
1 1/2	1.767	5.890	4 5/8	30.3	2	5	1.712	2.302	4 1/2	13	1 3/8	1.891	6.302	4 1/8	21.7
1 5/8	2.074	6.913	4 1/4	27.8	2 1/8	5	1.837	2.651	4 1/2	15					
1 3/4	2.405	8.018	4	25.7	2 1/4	5	1.962	3.023	4 1/2	18	1 1/2	2.250	7.500	4 3/4	34
1 7/8	2.761	9.204	4 1/8	23.9	2 3/8	5 1/2	2.087	3.410	4	20	1 5/8	2.641	8.802	4 5/8	29.6
2	3.142	10.47	3 7/8	18.3	2 1/2	5 1/2	2.175	3.716	4	24	1 3/4	3.063	10.21	4 1/4	21.3
2 1/8	3.547	11.82	3 5/8	17.1	2 5/8	5 1/2	2.300	4.155	4	28					
					2 3/4	6	2.425	4.619	4	30	1 7/8	3.516	11.72	5 1/8	31.4
2 1/4	3.976	13.25	4 5/8	28.5	2 7/8	6	2.550	5.107	3 1/2	34	2	4.000	13.33	4 3/4	27.7
2 3/8	4.430	14.77	4 3/8	22.6	3	6	2.629	5.430	3 1/2	38	2 1/8	4.516	15.05	4 3/8	20.2
2 1/2	4.909	16.36	4 3/8	21.3	3 1/8	6 1/2	2.754	5.957	8 1/2	50					
2 5/8	5.412	18.04	4 1/4	20.3	3 1/4	6 1/2	2.879	6.510	3 1/2	50	2 1/4	5.063	16.88	5 1/8	28.6
2 3/4	5.940	19.80	4 1/4	19.3	3 3/8	7	3.004	7.088	3 1/4	65					
					3 1/2	7	3.100	7.548	3 1/4	65	2 3/8	5.641	18.80	6 1/8	33.8
2 7/8	6.492	21.64	5 1/2	25.9	3 5/8	8	3.225	8.170	3 1/4		2 1/2	6.250	20.83	6 1/4	30.7
3	7.069	23.56	5 1/4	22.2	3 3/4	8	3.317	8.641	3 1/4						
3 1/8	7.670	25.57	5 1/8	21.3	3 7/8	8	3.442	9.305	3		2 5/8	6.891	22.97	6 3/4	35.0
3 1/4	8.296	27.65	4 7/8	20.7	4	8	3.567	9.9935	3		2 3/4	7.563	25.21	6	25.1

PROPORTION OF SQUARE RODS AND PINS.



PENCOYD STANDARD CLEVISES.

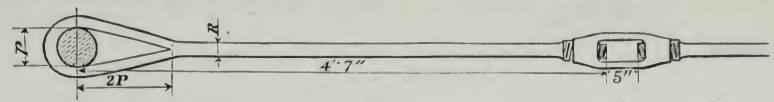
Tension allowed on Rod, 15,000 lbs. per sq. inch.
Shear allowed on Pin, 10,000 lbs. per sq. inch.
Bending allowed on Pin, 20,000 lbs. on extreme fibre.



DATA OF SQUARE RODS IN INCHES.

Diameter of Pin.	Rod.	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2⅝	2¾	2⅞	3	Diameter of Pin.
	Area.	1.00	1.27	1.56	1.89	2.25	2.64	3.06	3.52	4.00	4.52	5.06	5.64	6.25	6.89	7.56	8.27	9.00	
	Tension 15000 lbs.	15000	18980	23440	28360	33750	39610	45940	52730	60000	67730	75940	84610	93750	103360	113440	123980	135000	
	Upset.	1¼ x 4	1⅝ x 4½	1⅞ x 4½	2 x 5	2¼ x 5	2⅜ x 5½	2½ x 5½	2¾ x 6	2⅞ x 6	3 x 6	3¼ x 6½	3⅜ x 7	3⅝ x 8	3⅞ x 8	4 x 8			
1¾	Maximum lever arms in inches according to proportion of rod and pin.	1⅜	1¼	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	1¾
2		2 1/16	1⅝	1 5/16	1⅛	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	2
2¼		3	2⅜	1½	1 9/16	1 5/16	1½	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	2¼
2½		4 1/16	3¼	2⅜	2 3/16	1 13/16	1 9/16	1⅜	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	2½
2¾		5 7/16	4 5/16	3½	2⅞	2 7/16	2¼	1⅝	1 9/16	1⅜	. .	. .	. .	. .	. .	. .	. .	. .	2¾
3		. .	5 9/16	4½	3⅜	3⅛	2 11/16	2 5/16	2	1¾	1 9/16	1⅜	. .	. .	. .	. .	. .	. .	3
3¼		. .	. .	5½	4⅜	4	3 7/16	2 15/16	2 9/16	2¼	2	1 13/16	1⅝	1½	. .	. .	. .	. .	3¼
3½		. .	. .	. .	5 15/16	5	4¼	3 11/16	3 3/16	2 13/16	2½	2¼	2	1 13/16	1⅝	. .	. .	. .	3½
3¾		. .	. .	. .	. .	. .	5¼	4½	3 15/16	3 7/16	3	2¾	2 7/16	2 5/16	2	1 13/16	1 11/16	. .	3¾
4		. .	. .	. .	. .	. .	. .	5½	4¾	4 3/16	3½	3 5/16	3	2 11/16	2 7/16	2¼	2	1⅞	4
4¼		. .	. .	. .	. .	. .	. .	. .	. .	. .	4½	4	3 9/16	3 1/16	2 15/16	2 11/16	2 7/16	2¼	4¼
4½		. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	4¾	4¼	3 13/16	3½	3 3/16	2⅞	2 11/16	4½
4¾		. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	4⅛	4 7/16	3¾	3⅜	3⅛	4¾
5		. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	4¾	4 5/16	3 15/16	3⅝	5
5¼		. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	5	4 7/16	4⅛	5¼
5½		. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	5¾	5¼	4⅝	5½

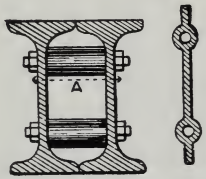
ALLOWANCE FOR EYE FOR SQUARE OR ROUND BARS.

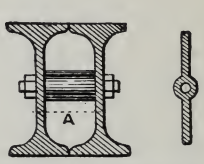


Formula: Length in inches beyond pin centre to form one eye equals 3.7 $(P + R)$.

Diameter of Pin in Inches.	Diameter or Side of Bars in Inches.																	Diameter of Pin in Inches.
	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2⅝	2¾	2⅞	3	
1	6½	7	7½																	1
1¼	7½	7⅞	8⅜	8⅞	9¼															1¼
1½	8⅜	8⅞	9¼	9¾	10¼	10⅝	11⅛													1½
1¾	9¼	9¾	10¼	10⅝	11⅛	11⅝	12	12½	13											1¾
2	10¼	10⅝	11⅛	11⅝	12	12½	13	13⅜	13⅞	14⅜	14¾									2
2¼	11⅛	11⅝	12	12½	13	13⅜	13⅞	14⅜	14¾	15¼	15¼	16⅛	16⅞							2¼
2½	12	12½	13	13⅜	13⅞	14⅜	14¾	15¼	15¾	16⅛	16⅝	17⅛	17⅝	18	18½					2½
2¾	13	13⅜	13⅞	14⅜	14¾	15¼	15¾	16⅛	16⅝	17⅛	17⅝	18	18½	19	19⅜	19⅞	20⅜			2¾
3	13⅞	14⅜	14¾	15¼	15¾	16⅛	16⅜	17⅛	17⅝	18	18½	19	19⅜	19⅞	20⅜	20⅞	21¼	21¾	22¼	3
3¼	14¾	15¼	15¾	16⅛	16⅝	17⅛	17⅝	18	18½	19	19⅜	19⅞	20⅜	20⅞	21¼	21¾	22¼	22⅝	23⅛	3¼
3½	15¾	16⅛	16⅝	17⅛	17⅝	18	18½	19	19⅜	19⅞	20⅜	20⅞	21¼	21¾	22¼	22⅝	23⅛	23⅝	24	3½
3¾	16⅝	17⅛	17⅝	18	18½	19	19⅜	19⅞	20⅜	20⅞	21¼	21¾	22¼	22⅝	23⅛	23⅝	24	24½	25	3¾
4	17⅝	18	18½	19	19⅜	19⅞	20⅜	20⅞	21¼	21¾	22¼	22⅝	23⅛	23⅝	24	24½	25	25½	26	4
4¼	18½	19	19⅜	19⅞	20⅜	20⅞	21¼	21¾	22¼	22⅝	23⅛	23⅝	24	24½	25	25½	26	26⅜	26⅞	4¼
4½	19⅜	19⅞	20⅜	20⅞	21¼	21¾	22¼	22⅝	23⅛	23⅝	24	24½	25	25½	26	26⅜	26⅞	27¼	27¾	4½
4¾	20⅜	20⅞	21¼	21¾	22¼	22⅝	23⅛	23⅝	24	24½	25	25½	26	26⅜	26⅞	27¼	27¾	28¼	28⅝	4¾
5	21¼	21¾	22¼	22⅝	23⅛	23⅝	24	24½	25	25½	26	26⅜	26⅞	27¼	27¾	28¼	28⅝	29⅛	29⅝	5
5¼	22¼	22⅝	23⅛	23⅝	24	24½	25	25½	26	26⅜	26⅞	27¼	27¾	28¼	28⅝	29⅛	29⅝	30	30½	5¼
5½	23⅛	23⅝	24	24½	25	25½	26	26⅜	26⅞	27¼	27¾	28¼	28⅝	29⅛	29⅝	30	30½	31	31½	5½
5¾	24	24½	25	25½	26	26⅜	26⅞	27¼	27¾	28¼	28⅝	29⅛	29⅝	30	30½	31	31½	32	32⅜	5¾
6	25	25½	26	26⅜	26⅞	27¼	27¾	28¼	28⅝	29⅛	29⅝	30	30½	31	31½	32	32⅜	32⅞	33⅜	6

STANDARD SEPARATORS FOR PENCOYD I BEAMS.





Size of Beam in Inches.	*Weight of Separator in Pounds.*	*Weight of each additional inch of width in Pounds.*	*Bolts, A.*		*Weight of each Complete Bolt in Pounds.*	*Weight per additional Inch of Length in Pounds.*
			Number.	*Size in Inches.*		
15	20	3.8	2	3/4	1.48	.124
12	14	3.1	2	3/4	1.40	.124
10 1/2	10	2.1	1	3/4	1.38	.124
10	9	2.0	1	3/4	1.32	.124
9	8	1.8	1	3/4	1.30	.124
8	6 1/2	1.6	1	3/4	1.28	.124
7	5	1.4	1	5/8	.84	.087
6	4	1.2	1	5/8	.82	.087
5	3	1.0	1	1/2	.45	.055
4	2	.85	1	1/2	.45	.055

The figures in the second column are the weights in pounds for cast-iron separators suitable for beams, placed with flanges in contact. When the flanges are separated, add the amount corresponding to the distance of separation, given in the third column. In the same way the weight of bolts may be obtained in the final columns.

WEIGHT OF BRIDGE RIVETS PER 100.

THIS TABLE ALSO APPLIES TO BUTTON-HEADED BOLTS.

Diam. of Rivet in Inches.	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4
Length of Rivet Under Head in Inches.	*Weight in Pounds.*	*Weight in Pounds.*	*Weight in Pounds.*	*Weight in Pounds.*	*Weight in Pounds.*	*Weight in Pounds.*	*Weight in Pounds.*	*Weight in Pounds.*
1 1/4	5.4	12.5	21.2	28.0	42.5	64.6	91.0	121.8
1 3/8	5.9	13.1	22.4	29.5	44.6	67.3	94.5	127.0
1 1/2	6.3	13.7	23.5	31.0	46.7	69.9	97.9	132.4
1 5/8	6.7	14.4	24.7	32.7	48.9	72.8	101.2	137.2
1 3/4	7.0	15.1	26.0	34.2	51.0	75.0	104.0	141.1
1 7/8	7.3	15.8	27.1	35.6	53.3	77.8	107.3	145.0
2	7.6	16.5	28.3	37.0	55.2	81.3	110.6	149.2
2 1/8	7.9	17.2	29.6	38.4	57.5	84.1	113.9	154.0
2 1/4	8.3	17.8	31.0	39.8	59.5	86.9	118.2	158.2
2 3/8	8.8	18.4	32.1	41.5	61.7	89.5	122.1	163.0
2 1/2	9.1	19.1	33.2	43.2	63.9	92.2	125.5	168.1
2 5/8	9.5	19.8	34.4	44.8	66.0	94.8	129.0	172.0
2 3/4	9.8	20.5	35.4	46.1	68.2	97.3	132.4	176.0
2 7/8	10.2	21.2	36.1	47.7	70.1	100.0	135.9	180.3
3	10.6	21.9	37.0	49.0	72.1	102.5	139.4	184.9
3 1/8	11.0	22.7	38.2	50.6	74.0	105.1	142.5	189.0
3 1/4	11.3	23.4	39.1	5.21	76.2	107.8	146.1	194.1
3 3/8	11.7	24.0	40.2	53.7	78.5	110.4	149.6	198.1
3 1/2	12.1	24.7	41.0	55.2	80.2	112.9	153.0	202.0
3 5/8	12.5	25.3	42.0	56.7	82.4	115.5	156.5	206.1
3 3/4	12.8	26.0	42.9	58.1	84.3	118.0	160.1	210.2
3 7/8	13.2	26.6	44.1	60.0	86.5	120.6	163.4	214.1
4	13.6	27.2	45.1	61.5	88.7	123.2	166.9	218.0
4 1/8	14.0	28.0	46.2	63.2	91.0	125.7	170.2	221.9
4 1/4	14.4	28.9	47.1	65.1	93.4	128.3	173.6	225.8
4 3/8	14.9	29.5	48.0	66.6	95.1	131.0	176.9	229.5
4 1/2	15.3	30.2	48.9	68.0	97.3	133.6	180.3	234.9
4 5/8	15.7	30.9	49.8	69.2	99.5	136.2	183.8	239.0
4 3/4	16.1	31.6	51.0	70.9	101.1	138.8	187.2	244.0
4 7/8	16.5	32.2	52.1	72.5	103.4	141.3	191.0	248.2
5	17.0	32.9	53.3	74.2	105.2	144.0	194.5	252.1
5 1/4	17.6	33.9	55.6	77.2	109.8	150.0	201.3	260.9
5 1/2	18.2	35.1	56.8	80.3	114.1	155.7	208.1	269.7
5 3/4	18.9	36.6	58.0	83.2	118.0	161.0	214.9	278.3
6	19.7	37.7	59.9	86.1	122.7	166.1	222.0	287.1
7	22.3	42.8	67.0	98.4	141.1	188.0	250.0	319.0
8	24.7	48.0	76.1	112.2	157.9	213.0	278.1	353.4
9	27.4	53.9	83.9	124.0	172.5	234.0	304.9	388.4
10	31.0	59.0	90.8	135.9	188.1	254.3	332.1	421.0
12	37.7	70.9	108.4	160.0	221.5	298.3	387.9	490.0

WEIGHT OF TWO (2) RIVET HEADS IN POUNDS.

	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4
Before driving..	.036	.114	.218	.268	.444	.76	1.14	1.64
After driving...	.031	.080	.160	.260	.440	.64	.778	1.07

WEIGHT OF BODY PER INCH OF LENGTH IN POUNDS.

	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4
Before driving..	.031	.54	.085	.123	.167	.218	.276	.341

WEIGHT OF BOLTS PER HUNDRED.

SQUARE HEADS AND NUTS.

Dimensions in inches.

Diameter.	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Length.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
1 1/2	3.9	9.7	20.4	37.	58.						
1 3/4	4.2	10.5	21.3	37.9	60.5						
2	4.6	11.3	22.4	39.9	63.2	97.7	145				
2 1/4	5.	12.1	23.6	42.	66.	101.6	149				
2 1/2	5.4	12.9	25.	44.4	69.	105.6	153				
2 3/4	5.8	13.7	26.4	46.2	72.1	109.7	158				
3	6.2	14.5	27.8	48.3	75.2	113.8	163	200	289	350	480
3 1/2	6.9	16.1	30.6	52.5	81.4	122.	174	213	305	370	500
4	7.6	17.7	33.4	56.7	87.6	130.2	185	226	322	390	520
4 1/2	8.3	19.2	36.2	60.9	93.8	138.4	196	240	339	410	545
5	9.	20.7	39.	65.1	100.	146.6	207	255	356	430	570
5 1/2	9.7	22.2	41.8	69.2	106.1	154.9	218	270	373	450	595
6	10.4	23.7	44.6	73.4	112.2	163.2	229	285	390	470	620
6 1/2	11.1	25.2	47.4	77.6	118.3	171.5	240	300	407	490	645
7	11.8	26.7	50.2	81.8	124.4	179.8	251	315	434	510	670
7 1/2	12.5	28.2	53.1	86.	130.5	187.1	262	330	451	530	695
8	13.2	29.7	56.	90.	136.6	195.4	273	345	468	550	725
9		33.1	61.5	98.	148.8	212.	295	375	505	590	775
10		36.5	67.	106.3	161.	229.	317	405	540	630	825
11		40.0	72.5	114.6	173.2	246.	339	435	575	670	875
12		43.5	78.	122.9	184.4	263.	361	465	610	710	925
13			83.5	131.2	196.6	280.	383	495	645	751	975
14			89.	139.5	208.8	297.	405	525	680	793	1025
15			94.5	148.	221.	314.	427	555	715	835	1075
16			100.	156.5	233.2	331.	449	585	750	877	1125
17			105.5	165.	245.4	348.	471	615	785	919	1175
18			111.	173.5	257.6	365.	493	645	820	961	1225

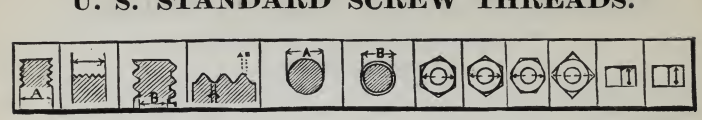
WEIGHT OF BOLTS PER HUNDRED.

HEXAGON HEADS AND NUTS.

Dimensions in inches.

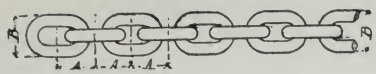
Diameter.	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Length.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
1 1/2	3.4	8.5	17.7	32.5	49.0						
1 3/4	3.7	9.3	18.6	33.4	51.5						
2	4.1	10.1	19.7	35.4	54.2	86.6	128				
2 1/4	4.5	10.9	20.9	37.5	57.0	90.6	132				
2 1/2	4.9	11.7	22.3	39.9	60.0	94.6	136				
2 3/4	5.3	12.5	23.7	41.7	63.1	98.7	141				
3	5.7	13.3	25.1	43.8	66.2	102.8	144	174	255	310	430
3 1/2	6.1	14.1	26.6	45.7	69.4	107.0	151	187	271	330	450
4	6.8	15.7	29.4	49.9	75.6	115.2	162	200	288	350	470
4 1/2	7.5	17.0	32.2	56.1	81.8	123.4	173	214	305	370	495
5	8.2	18.7	35.0	58.3	88.0	131.6	184	229	322	390	520
5 1/2	8.9	20.2	37.8	62.4	94.1	139.9	195	244	339	410	545
6	9.6	21.7	40.6	66.6	100.2	148.2	206	259	356	430	570
6 1/2	10.3	23.2	43.4	70.8	106.3	156.5	217	274	373	450	595
7	11.0	24.7	46.2	75.0	112.4	164.8	228	289	400	470	620
7 1/2	11.7	26.2	49.1	79.2	118.5	172.1	239	304	417	490	645
8	12.4	27.7	52.0	83.2	124.6	180.3	250	319	424	510	670
9		29.7	54.8	87.0	130.8	189.0	262	336	465	530	700
10		33.1	60.3	95.0	143.0	206.0	284	366	500	579	750
11		36.6	65.8	103.6	155.2	223.0	306	396	535	610	800
12		40.1	71.3	111.9	166.4	240.0	328	426	570	650	850
13			76.8	120.2	178.6	257.0	350	456	605	691	900
14			82.3	128.5	190.8	274.0	372	486	640	733	950
15			87.8	137.0	203.0	291.0	384	516	675	775	1000
16			93.3	145.5	215.2	308.0	416	546	710	817	1050
17			98.8	154.0	227.4	325.0	438	576	745	859	1100
18			104.3	162.5	239.6	342.0	460	606	780	901	1150

U. S. STANDARD SCREW THREADS.



Diam.	Threads per Inch.	Diam. of Root of Thread.	Width of Flat.	Area of Bolt Body in Sq. Inches.	Area at Root of Thread in Sq. Inches.	Short Diam., Rough.	Short Diam., Finish.	Long Diam., Rough.	Long Diam., Rough.	Thickness, Rough.	Thickness, Finish.
Ins.		*Ins.*	*Ins.*			*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Ins.*	*Ins.*
$\frac{1}{4}$	20	.185	.0062	.049	.027	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{37}{64}$	$\frac{7}{10}$	$\frac{1}{4}$	$\frac{3}{16}$
$\frac{5}{16}$	18	.240	.0074	.077	.045	$\frac{19}{32}$	$\frac{17}{32}$	$\frac{11}{16}$	$\frac{10}{12}$	$\frac{5}{16}$	$\frac{1}{4}$
$\frac{3}{8}$	16	.294	.0078	.110	.068	$\frac{11}{16}$	$\frac{5}{8}$	$\frac{51}{64}$	$\frac{63}{64}$	$\frac{3}{8}$	$\frac{5}{16}$
$\frac{7}{16}$	14	.344	.0089	.150	.093	$\frac{25}{32}$	$\frac{23}{32}$	$\frac{9}{10}$	$1\frac{7}{64}$	$\frac{7}{16}$	$\frac{3}{8}$
$\frac{1}{2}$	13	.400	.0096	.196	.126	$\frac{7}{8}$	$\frac{13}{16}$	1	$1\frac{5}{64}$	$\frac{1}{2}$	$\frac{7}{16}$
$\frac{9}{16}$	12	.454	.0104	.249	.162	$\frac{31}{32}$	$\frac{29}{32}$	$1\frac{1}{8}$	$1\frac{23}{64}$	$\frac{9}{16}$	$\frac{1}{2}$
$\frac{5}{8}$	11	.507	.0113	.307	.202	$1\frac{1}{16}$	1	$1\frac{7}{32}$	$1\frac{1}{2}$	$\frac{5}{8}$	$\frac{9}{16}$
$\frac{3}{4}$	10	.620	.0125	.442	.302	$1\frac{1}{4}$	$1\frac{3}{16}$	$1\frac{7}{16}$	$1\frac{49}{64}$	$\frac{3}{4}$	$\frac{11}{16}$
$\frac{7}{8}$	9	.731	.0138	.601	.420	$1\frac{7}{16}$	$1\frac{3}{8}$	$1\frac{21}{32}$	$2\frac{1}{32}$	$\frac{7}{8}$	$\frac{13}{16}$
1	8	.837	.0156	.785	.550	$1\frac{5}{8}$	$1\frac{9}{16}$	$1\frac{7}{8}$	$2\frac{9}{64}$	1	$\frac{15}{16}$
$1\frac{1}{8}$	7	.940	.0178	.994	.694	$1\frac{13}{16}$	$1\frac{3}{4}$	$2\frac{3}{32}$	$2\frac{9}{16}$	$1\frac{1}{8}$	$1\frac{1}{16}$
$1\frac{1}{4}$	7	1.065	.0178	1.227	.893	2	$1\frac{15}{16}$	$2\frac{5}{16}$	$2\frac{53}{64}$	$1\frac{1}{4}$	$1\frac{3}{16}$
$1\frac{3}{8}$	6	1.160	.0208	1.485	1.057	$2\frac{3}{16}$	$2\frac{1}{16}$	$2\frac{17}{32}$	$3\frac{3}{32}$	$1\frac{3}{8}$	$1\frac{5}{16}$
$1\frac{1}{2}$	6	1.284	.0208	1.767	1.295	$2\frac{3}{8}$	$2\frac{5}{16}$	$2\frac{3}{8}$	$3\frac{23}{64}$	$1\frac{1}{2}$	$1\frac{7}{16}$
$1\frac{5}{8}$	$5\frac{1}{2}$	1.389	.0227	2.074	1.515	$2\frac{9}{16}$	$2\frac{1}{2}$	$2\frac{31}{32}$	$3\frac{5}{8}$	$1\frac{5}{8}$	$1\frac{9}{16}$
$1\frac{3}{4}$	5	1.491	.0250	2.405	1.746	$2\frac{3}{4}$	$2\frac{11}{16}$	$3\frac{3}{16}$	$3\frac{57}{64}$	$1\frac{3}{4}$	$1\frac{11}{16}$
$1\frac{7}{8}$	5	1.616	.0250	2.761	2.051	$2\frac{7}{8}$	$2\frac{13}{16}$	$3\frac{13}{32}$	$4\frac{5}{32}$	$1\frac{7}{8}$	$1\frac{13}{16}$
2	$4\frac{1}{2}$	1.712	.0277	3.142	2.302	$3\frac{1}{8}$	$3\frac{1}{16}$	$3\frac{5}{8}$	$4\frac{27}{64}$	2	$1\frac{15}{16}$
$2\frac{1}{4}$	$4\frac{1}{2}$	1.962	.0277	3.976	3.023	$3\frac{1}{2}$	$3\frac{7}{16}$	$4\frac{1}{16}$	$4\frac{61}{64}$	$2\frac{1}{4}$	$2\frac{3}{16}$
$2\frac{1}{2}$	4	2.176	.0312	4.909	3.719	$3\frac{7}{8}$	$3\frac{13}{16}$	$4\frac{1}{2}$	$5\frac{31}{64}$	$2\frac{1}{2}$	$2\frac{7}{16}$
$2\frac{3}{4}$	4	2.426	.0312	5.940	4.620	$4\frac{1}{4}$	$4\frac{3}{16}$	$4\frac{29}{32}$	6	$2\frac{3}{4}$	$2\frac{11}{16}$
3	$3\frac{1}{2}$	2.629	.0357	7.069	5.428	$4\frac{5}{8}$	$4\frac{9}{16}$	$5\frac{3}{8}$	$6\frac{17}{64}$	3	$2\frac{15}{16}$
$3\frac{1}{4}$	$3\frac{1}{2}$	2.879	.0357	8.296	6.510	5	$4\frac{15}{16}$	$5\frac{13}{16}$	$7\frac{1}{16}$	$3\frac{1}{4}$	$3\frac{3}{16}$
$3\frac{1}{2}$	$3\frac{1}{4}$	3.100	.0384	9.621	7.548	$5\frac{3}{8}$	$5\frac{5}{16}$	$6\frac{7}{64}$	$7\frac{33}{64}$	$3\frac{1}{2}$	$3\frac{7}{16}$
$3\frac{3}{4}$	3	3.317	.0413	11.045	8.641	$5\frac{3}{4}$	$5\frac{11}{16}$	$6\frac{21}{32}$	$8\frac{1}{8}$	$3\frac{3}{4}$	$3\frac{11}{16}$
4	3	3.567	.0413	12.566	9.963	$6\frac{1}{8}$	$6\frac{1}{16}$	$7\frac{3}{32}$	$8\frac{41}{64}$	4	$3\frac{15}{16}$
$4\frac{1}{4}$	$2\frac{7}{8}$	3.798	.0435	14.186	11.329	$6\frac{1}{2}$	$6\frac{7}{16}$	$7\frac{29}{32}$	$9\frac{3}{16}$	$4\frac{1}{4}$	$4\frac{3}{16}$
$4\frac{1}{2}$	$2\frac{3}{4}$	4.028	.0454	15.904	12.753	$6\frac{13}{16}$	$6\frac{3}{4}$	$7\frac{31}{32}$	$9\frac{3}{4}$	$4\frac{1}{4}$	$4\frac{7}{16}$
$4\frac{3}{4}$	$2\frac{5}{8}$	4.256	.0476	17.721	14.226	$7\frac{1}{4}$	$7\frac{3}{16}$	$8\frac{13}{32}$	$10\frac{1}{4}$	$4\frac{3}{4}$	$4\frac{11}{16}$
5	$2\frac{1}{2}$	4.480	.0500	19.635	15.763	$7\frac{5}{8}$	$7\frac{9}{16}$	$8\frac{27}{32}$	$10\frac{49}{64}$	5	$4\frac{15}{16}$
$5\frac{1}{4}$	$2\frac{3}{8}$	4.730	.0500	21.648	17.572	8	$7\frac{15}{16}$	$9\frac{9}{32}$	$11\frac{23}{64}$	$5\frac{1}{4}$	$5\frac{3}{16}$
$5\frac{1}{2}$	$2\frac{3}{8}$	4.953	.0526	23.758	19.267	$8\frac{3}{8}$	$8\frac{5}{16}$	$9\frac{33}{32}$	$11\frac{7}{8}$	$5\frac{1}{2}$	$5\frac{7}{16}$
$5\frac{3}{4}$	$2\frac{3}{8}$	5.203	.0526	25.967	21.262	$8\frac{3}{4}$	$8\frac{11}{16}$	$10\frac{5}{32}$	$12\frac{3}{8}$	$5\frac{3}{4}$	$5\frac{11}{16}$
6	$2\frac{1}{4}$	5.423	.0555	28.274	23.098	$9\frac{1}{8}$	$9\frac{1}{16}$	$10\frac{19}{32}$	$12\frac{15}{16}$	6	$5\frac{15}{16}$

CRANE CHAINS.



"D. B. G." SPECIAL CRANE.							CRANE.		
Size of Chain. Inches.	*Pitch A. Approximately. Inches.*	*Weight per Foot in Pounds. Approximately.*	*Outside Width. B. Inches.*	*Proof Test. Pounds.*	*Average Breakage Strain. Pounds.*	*Ordinary Safe Load. General Use. Pounds.*	*Proof Test. Pounds.*	*Average Breaking Strain. Pounds.*	*Ordinary Safe Load. General Use. Pounds.*
$\frac{1}{4}$	$\frac{25}{32}$	$\frac{7}{8}$	$\frac{7}{8}$	1932	3864	1288	1680	3360	1120
$\frac{5}{16}$	$\frac{31}{32}$	1	$1\frac{1}{16}$	2898	5796	1932	2520	5040	1680
$\frac{3}{8}$	$1\frac{1}{32}$	$1\frac{7}{10}$	$1\frac{1}{4}$	4186	8372	2790	3640	7280	2427
$\frac{7}{16}$	$1\frac{5}{32}$	2	$1\frac{3}{8}$	5796	11592	3864	5040	10080	3360
$\frac{1}{2}$	$1\frac{11}{32}$	$2\frac{1}{2}$	$1\frac{11}{16}$	7728	15456	5182	6720	13440	4480
$\frac{9}{16}$	$1\frac{15}{32}$	$3\frac{2}{10}$	$1\frac{7}{8}$	9660	19320	6440	8400	16800	5600
$\frac{5}{8}$	$1\frac{23}{32}$	$4\frac{1}{5}$	$2\frac{1}{16}$	11914	23828	7942	10360	20720	6907
$\frac{11}{16}$	$1\frac{27}{32}$	5	$2\frac{1}{4}$	14490	28980	9660	12600	25200	8400
$\frac{3}{4}$	$1\frac{31}{32}$	$5\frac{7}{8}$	$2\frac{1}{2}$	17388	34776	11592	15120	30240	10080
$\frac{13}{16}$	$2\frac{3}{32}$	$6\frac{7}{10}$	$2\frac{11}{16}$	20286	40572	13524	17640	35280	11760
$\frac{7}{8}$	$2\frac{7}{32}$	8	$2\frac{7}{8}$	22484	44968	14989	20440	40880	13627
$\frac{15}{16}$	$2\frac{15}{32}$	9	$3\frac{1}{16}$	25872	51744	17248	23520	47040	15680
1	$2\frac{19}{32}$	$10\frac{7}{10}$	$3\frac{1}{4}$	29568	59136	19712	26880	53760	17920
$1\frac{1}{16}$	$2\frac{23}{32}$	$11\frac{2}{10}$	$3\frac{5}{16}$	33264	66538	22176	30240	60480	20160
$1\frac{1}{8}$	$2\frac{27}{32}$	$12\frac{1}{2}$	$3\frac{1}{4}$	37576	75152	25050	34160	68320	22773
$1\frac{3}{16}$	$3\frac{5}{32}$	$13\frac{7}{10}$	$3\frac{7}{8}$	41888	83776	27925	38080	76160	25387
$1\frac{1}{4}$	$3\frac{7}{32}$	16	$4\frac{1}{8}$	46200	92400	30800	42000	84000	28000
$1\frac{5}{16}$	$3\frac{15}{32}$	$16\frac{1}{2}$	$4\frac{1}{4}$	50312	101024	33674	45920	91810	30613
$1\frac{3}{8}$	$3\frac{23}{32}$	$17\frac{7}{10}$	$4\frac{9}{16}$	55748	111496	27165	50680	101360	33787
$1\frac{7}{16}$	$3\frac{27}{32}$	$19\frac{2}{10}$	$4\frac{1}{2}$	69368	120736	40245	54880	109760	36587
$1\frac{1}{2}$	$3\frac{31}{32}$	$21\frac{7}{10}$	5	66528	133056	44352	60480	120960	40320

The distance from centre of one link to centre of next is equal to the inside length of link, but in practice $\frac{1}{32}$ inch is allowed for weld. This is approximate, and where exactness is required, chain should be made so.

FOR CHAIN SHEAVES.—The diameter, if possible, should be not less than twenty times the diameter of chain used. *Example*—For 1-inch chain use 20-inch sheaves.

DECIMAL EQUIVALENTS FOR VULGAR FRACTIONS.

The given decimals are the parts of inches corresponding to fraction of inches in first column; also, the parts of feet for the fraction of inches in second column.

	1/16	.0052		3 1/16	.2552		6 1/16	.5052		9 1/16	.7552
	1/8	.0104		3 1/8	.2604		6 1/8	.5104		9 1/8	.7604
1/64	3/16	.015625	17/64	3 3/16	.265625	33/64	6 3/16	.515625	49/64	9 3/16	.765625
	1/4	.0208		3 1/4	.2708		6 1/4	.5208		9 1/4	.7708
	5/16	.0260		3 5/16	.2760		6 5/16	.5260		9 5/16	.7760
1/32	3/8	.03125	9/32	3 3/8	.28125	17/32	6 3/8	.53125	25/32	9 3/8	.78125
	7/16	.0364		3 7/16	.2865		6 7/16	.6364		9 7/16	.7865
	1/2	.0417		3 1/2	.2917		6 1/2	.5411		9 1/2	.7917
3/64	9/16	.046875	19/64	3 9/16	.296875	35/64	6 9/16	.546875	51/64	9 9/16	.796875
	5/8	.0521		3 5/8	.3021		6 5/8	.5521		9 5/8	.8021
	11/16	.0573		3 11/16	.3073		6 11/16	.5573		9 11/16	.8073
1/16	3/4	.0625	5/16	3 3/4	.3125	9/16	6 3/4	.5625	13/16	9 3/4	.8125
	13/16	.0677		3 13/16	.3177		6 13/16	.5677		9 13/16	.8177
	7/8	.0729		3 7/8	.3229		6 7/8	.5729		9 7/8	.8229
5/64	15/16	.078125	21/64	3 15/16	.328125	37/64	6 15/16	.578125	53/64	9 15/16	.828125
	1	.0833		4	.3333		7	.5833		10	.8333
	1 1/16	.0885		4 1/16	.3385		7 1/16	.5885		10 1/16	.8385
3/32	1 1/8	.09375	11/32	4 1/8	.34375	19/32	7 1/8	.59375	27/32	10 1/8	.84375
	1 3/16	.0990		4 3/16	.3490		7 3/16	.5990		10 3/16	.8490
	1 1/4	.1042		4 1/4	.3542		7 1/4	.6042		10 1/4	.8542
7/64	1 5/16	.109375	23/64	4 5/16	.359375	39/64	7 5/16	.609375	55/64	10 5/16	.859375
	1 3/8	.1146		4 3/8	.3646		7 3/8	.6146		10 3/8	.8646
	1 7/16	.1198		4 7/16	.3698		7 7/16	.6198		10 7/16	.8698
1/8	1 1/2	.1250	3/8	4 1/2	.3750	5/8	7 1/2	.6250	7/8	10 1/2	.8750
	1 9/16	.1302		4 9/16	.3802		7 9/16	.6302		10 9/16	.8802
	1 5/8	.1354		4 5/8	.3854		7 5/8	.6354		10 5/8	.8854
9/64	1 11/16	.140625	25/64	4 11/16	.390625	41/64	7 11/16	.640625	57/64	10 11/16	.890625
	1 3/4	.1458		4 3/4	.3958		7 3/4	.6453		10 3/4	.8958
	1 13/16	.1510		4 13/16	.4010		7 13/16	.6510		10 13/16	.9010
5/32	1 7/8	.15625	13/32	4 7/8	.40625	21/32	7 7/8	.65625	29/32	10 7/8	.90625
	1 15/16	.1615		4 15/16	.4114		7 15/16	.6615		10 15/16	.9115
	2	.1667		5	.4167		8	.6667		11	.9167
11/64	2 1/16	.171875	27/64	5 1/16	.421875	43/64	8 1/16	.671875	59/64	11 1/16	.921875
	2 1/8	.1771		5 1/8	.4271		8 1/8	.6771		11 1/8	.9271
	2 3/16	.1823		5 3/16	.4323		8 3/16	.6823		11 3/16	.9323
3/16	2 1/4	.1875	7/16	5 1/4	.4375	11/16	8 1/4	.6875	15/16	11 1/4	.9375
	2 5/16	.1927		5 5/16	.4427		8 5/16	.6927		11 5/16	.9427
	2 3/8	.1979		5 3/8	.4479		8 3/8	.6979		11 3/8	.9479
13/64	2 7/16	.203125	29/64	5 7/16	.453125	45/64	8 7/16	.703125	61/64	11 7/16	.953125
	2 1/2	.2083		5 1/2	.4583		8 1/2	.7083		11 1/2	.9583
	2 9/16	.2135		5 9/16	.4635		8 9/16	.7135		11 9/16	.9635
7/32	2 5/8	.21875	15/32	5 5/8	.46875	23/32	8 5/8	.71875	31/32	11 5/8	.96875
	2 11/16	.2240		5 11/16	.4740		8 11/16	.7240		11 11/16	.9740
	2 3/4	.2292		5 3/4	.4792		8 3/4	.7292		11 3/4	.9792
15/64	2 13/16	.234375	31/64	5 13/16	.484375	47/64	8 13/16	.734375	63/64	11 13/16	.984375
	2 7/8	.2395		5 7/8	.4896		8 7/8	.7396		11 7/8	.9896
	2 15/16	.2448		5 15/16	.4948		8 15/16	.7448		11 15/16	.9948
1/4	3	.2500	1/2	6	.5000	3/4	9	.7500	1	12	1.0000

AREAS AND CIRCUMF. OF CIRCLES.

Diam. Ins.	Circumf. Ins.	Area. Sq. Ins.	Diam. Ins.	Circumf. Ins.	Area. Sq. Ins.	Diam. Ins.	Circumf. Ins.	Area. Sq. Ins.
1/64	.049087	.00019						
1/32	.098175	.00077	2	6.28319	3.1416	5	15.7080	19.635
3/64	.147262	.00173	1/16	6.47953	3.3410	1/16	15.9043	20.129
1/16	.196350	.00307	1/8	6.67588	3.5466	1/8	16.1007	20.629
3/32	.294524	.00690	3/16	6.87223	3.7583	3/16	16.2970	21.135
1/8	.392699	.01227	1/4	7.06858	3.9761	1/4	16.4934	21.648
5/32	.490874	.01917	5/16	7.26493	4.2000	5/16	16.6897	22.166
3/16	.589049	.02761	3/8	7.46128	4.4301	3/8	16.8861	22.691
7/32	.687223	.03758	7/16	7.65763	4.6664	7/16	17.0824	23.221
1/4	.785398	.04909	1/2	7.85398	4.9087	1/2	17.2788	23.758
9/32	.883573	.06213	9/16	8.05033	5.1572	9/16	17.4751	24.301
5/16	.981748	.07670	5/8	8.24668	5.4119	5/8	17.6715	24.850
11/32	1.07992	.09281	11/16	8.44303	5.6727	11/16	17.8678	25.406
3/8	1.17810	.11045	3/4	8.63938	5.9396	3/4	18.0642	25.967
13/32	1.27627	.12962	13/16	8.83573	6.2126	13/16	18.2605	26.535
7/16	1.37445	.15033	7/8	9.03208	6.4918	7/8	18.4569	27.109
15/32	1.47262	.17257	15/16	9.22843	6.7771	15/16	18.6532	27.688
1/2	1.57080	.19635	3	9.42478	7.0686	6	18.8496	28.274
17/32	1.66897	.22166	1/16	9.62113	7.3662	1/8	19.2423	29.465
9/16	1.76715	.24850	1/8	9.81748	7.6699	1/4	19.6350	30.680
19/32	1.86532	.27688	3/16	10.0138	7.9798	3/8	20.0277	31.919
5/8	1.96350	.30680	1/4	10.2102	8.2958	1/2	20.4204	33.183
21/32	2.06167	.33824	5/16	10.4065	8.6179	5/8	20.8131	34.472
11/16	2.15984	.37122	3/8	10.6029	8.9462	3/4	21.2058	35.785
23/32	2.25802	.40574	7/16	10.7992	9.2806	7/8	21.5984	37.122
3/4	2.35619	.44179	1/2	10.9956	9.6211	7	21.9911	38.485
25/32	2.45437	.47937	9/16	11.1919	9.9678	1/8	22.3838	39.871
13/16	2.55254	.51849	5/8	11.3883	10.321	1/4	22.7765	41.282
27/32	2.65072	.55914	11/16	11.5846	10.680	3/8	23.1692	42.718
7/8	2.74889	.60132	3/4	11.7810	11.045	1/2	28.5619	44.179
29/32	2.84707	.64504	13/16	11.9773	11.416	5/8	23.9546	45.664
15/16	2.94524	.69029	7/8	12.1737	11.793	3/4	24.3473	47.173
31/32	3.04342	.73708	15/16	12.3700	12.177	7/8	24.7400	48.707
1	3.14159	.78540	4	12.5664	12.566	8	25.1327	50.265
1/16	3.33794	.88664	1/16	12.7627	12.962	1/8	25.5224	51.849
1/8	3.53429	.99402	1/8	12.9591	13.364	1/4	25.9181	53.456
3/16	3.73064	1.1075	3/16	13.1554	13.772	3/8	26.3108	55.088
1/4	3.92699	1.2272	1/4	13.3518	14.186	1/2	26.7035	56.745
5/16	4.12334	1.3530	5/16	13.5481	14.607	5/8	27.0962	58.426
3/8	4.31969	1.4849	3/8	13.7445	15.033	3/4	27.4889	60.132
7/16	4.51604	1.6230	7/16	13.9408	15.466	7/8	27.8816	61.862
1/2	4.71239	1.7671	1/2	14.1372	15.904	9	28.2743	63.617
9/16	4.90874	1.9175	9/16	14.3335	16.349	1/8	28.6670	65.397
5/8	5.10509	2.0739	5/8	14.5299	16.800	1/4	29.0597	67.201
11/16	5.30144	2.2365	11/16	14.7262	17.257	3/8	29.4524	69.029
3/4	5.49779	2.4053	3/4	14.9226	17.721	1/2	29.8451	70.882
13/16	5.69414	2.5802	13/16	15.1189	18.190	5/8	30.2378	72.760
7/8	5.89049	2.7612	7/8	15.3153	18.665	3/4	30.6305	74.662
15/16	6.08684	2.9483	15/16	15.5116	19.147	7/8	31.0232	76.589

AREAS AND CIRCUMF. OF CIRCLES.

Diam. Ins.	Circumf. Ins.	Area Sq. Ins.	Diam. Ins.	Circumf. Ins.	Area Sq. Ins.	Diam. Ins.	Circumf. Ins.	Area Sq. Ins.
10	31.4159	78.540	16	50.2655	201.06	22	69.1150	380.13
1/8	31.8086	80.516	1/8	50.6582	204.22	1/8	69.5077	384.46
1/4	32.2013	82.516	1/4	51.0509	207.39	1/4	69.9004	388.82
3/8	32.5940	84.541	3/8	51.4436	210.60	3/8	70.2931	393.20
1/2	32.9867	86.590	1/2	51.8363	213.82	1/2	70.6858	397.61
5/8	33.3794	88.664	5/8	52.2290	217.08	5/8	71.0785	402.04
3/4	33.7721	90.763	3/4	52.6217	220.35	3/4	71.4712	406.49
7/8	34.1648	92.886	7/8	53.0144	223.65	7/8	71.8639	410.97
11	34.5575	95.033	17	53.4071	226.98	23	72.2566	415.48
1/8	34.9502	97.205	1/8	53.7998	230.33	1/8	72.6493	420.00
1/4	35.3429	99.402	1/4	54.1925	233.71	1/4	73.0420	424.56
3/8	35.7356	101.62	3/8	54.5852	237.10	3/8	73.4347	429.13
1/2	36.1283	103.87	1/2	54.9779	240.53	1/2	73.8274	433.74
5/8	36.5210	106.14	5/8	55.3706	243.98	5/8	74.2201	438.36
3/4	36.9137	108.43	3/4	65.7633	247.45	3/4	74.6128	443.01
7/8	37.3064	110.75	7/8	56.1560	250.95	7/8	75.0055	447.69
12	37.6991	113.10	18	56.5487	254.47	24	75.3982	452.39
1/8	38.0918	115.47	1/8	56.9414	258.02	1/8	75.7909	457.11
1/4	38.4845	117.86	1/4	57.3341	261.59	1/4	76.1836	461.86
3/8	38.8772	120.28	3/8	57.7268	265.18	3/8	76.5763	466.64
1/2	39.2699	122.72	1/2	58.1195	268.80	1/2	76.9690	471.44
5/8	39.6626	125.19	5/8	58.5122	272.45	5/8	77.3617	476.26
3/4	40.0553	127.68	3/4	58.9049	276.12	3/4	77.7544	481.11
7/8	40.4480	130.19	7/8	59.2976	279.81	7/8	78.1471	485.98
13	40.8407	132.73	19	59.6903	283.53	25	78.5398	490.87
1/8	41.2334	135.30	1/8	60.0830	287.27	1/8	78.9325	495.79
1/4	41.6261	137.89	1/4	60.4757	291.04	1/4	79.3252	500.74
3/8	42.0188	140.50	3/8	60.8684	294.83	3/8	79.7179	505.71
1/2	42.4115	143.14	1/2	61.2611	298.65	1/2	80.1106	510.71
5/8	42.8042	145.80	5/8	61.6538	302.49	5/8	80.5033	515.72
3/4	43.1969	148.49	3/4	62.0465	306.35	3/4	80.8960	520.77
7/8	43.5896	151.20	7/8	62.4392	310.24	7/8	81.2887	525.84
14	43.9823	153.94	20	62.8319	314.16	26	81.6814	530.93
1/8	44.3750	156.70	1/8	63.2246	318.10	1/8	82.0741	536.05
1/4	44.7677	159.48	1/4	63.6173	322.06	1/4	82.4668	541.19
3/8	45.1604	162.30	3/8	64.0100	326.05	3/8	82.8595	546.35
1/2	45.5531	165.13	1/2	64.4026	330.06	1/2	83.2522	551.55
5/8	45.9458	167.99	5/8	64.7953	334.10	5/8	83.6449	556.76
3/4	46.3385	170.87	3/4	66.1880	338.16	3/4	84.0376	562.00
7/8	46.7312	173.78	7/8	65.5807	342.25	7/8	84.4303	567.27
15	47.1239	176.71	21	65.9734	346.36	27	84.8230	572.56
1/8	47.5166	179.67	1/8	66.3661	350.50	1/8	85.2157	577.87
1/4	47.9093	182.65	1/4	66.7588	354.66	1/4	85.6084	583.21
3/8	48.3020	185.66	3/8	67.1515	358.84	3/8	86.0011	588.57
1/2	48.6947	188.69	1/2	67.5442	363.05	1/2	86.3938	593.96
5/8	49.0874	191.75	5/8	67.9369	367.28	5/8	86.7865	599.37
3/4	49.4801	194.83	3/4	68.3296	371.54	3/4	87.1792	604.81
7/8	49.8728	197.93	7/8	68.7223	375.83	7/8	87.5719	610.27

AREAS AND CIRCUMF. OF CIRCLES.

Diam. Ins.	*Circumf. Ins.*	*Area. Sq. Ins.*	*Diam. Ins.*	*Circumf. Ins.*	*Area. Sq. Ins.*	*Diam. Ins.*	*Circumf. Ins.*	*Area. Sq. Ins.*
28	87.9646	615.75	34	106.814	907.92	40	125.664	1256.6
1/8	88.3573	621.26	1/8	107.207	914.61	1/8	126.056	1264.5
1/4	88.7500	626.80	1/4	107.600	921.32	1/4	126.449	1272.4
3/8	89.1427	632.36	3/8	107.992	928.06	3/8	126.842	1280.3
1/2	89.5354	637.94	1/2	108.385	934.82	1/2	127.235	1288.2
5/8	89.9281	643.55	5/8	108.788	941.61	5/8	127.627	1296.2
3/4	90.3208	649.18	3/4	109.170	948.42	3/4	128.020	1304.2
7/8	90.7135	654.84	7/8	109.563	955.25	7/8	128.413	1312.2
29	91.1062	660.52	35	109.956	962.11	41	128.805	1320.3
1/8	91.4989	666.23	1/8	110.348	969.00	1/8	129.198	1328.3
1/4	91.8916	671.96	1/4	110.741	975.91	1/4	129.591	1336.4
3/8	92.2843	677.71	3/8	111.134	982.84	3/8	129.993	1344.5
1/2	92.6770	683.49	1/2	111.527	989.80	1/2	130.376	1352.7
5/8	93.0697	689.30	5/8	111.919	996.78	5/8	130.769	1360.8
3/4	93.4624	695.13	3/4	112.312	1003.8	3/4	131.161	1369.0
7/8	93.8551	700.98	7/8	112.705	1010.8	7/8	131.554	1377.2
30	94.2478	706.86	36	113.097	1017.9	42	131.947	1385.4
1/8	94.6405	712.76	1/8	113.490	1025.0	1/8	132.340	1393.7
1/4	95.0332	718.69	1/4	113.883	1032.1	1/4	132.732	1402.0
3/8	95.4259	724.64	3/8	114.275	1039.2	3/8	133.125	1410.3
1/2	95.8186	730.62	1/2	114.668	1046.3	1/2	133.518	1418.6
5/8	96.2113	736.62	5/8	115.061	1053.5	5/8	133.910	1427.0
3/4	96.6040	742.64	3/4	115.454	1060.7	3/4	134.303	1435.4
7/8	96.9967	748.69	7/8	115.846	1068.0	7/8	134.696	1443.8
31	97.3894	754.77	37	116.239	1075.2	43	135.088	1452.2
1/8	97.7821	760.87	1/8	116.632	1082.5	1/8	135.481	1460.7
1/4	98.1748	766.99	1/4	117.024	1089.8	1/4	135.874	1469.1
3/8	98.5675	773.14	3/8	117.417	1097.1	3/8	136.267	1477.6
1/2	98.9602	779.31	1/2	117.810	1104.5	1/2	136.659	1486.2
5/8	99.3529	785.51	5/8	118.202	1111.8	5/8	137.052	1494.7
3/4	99.7456	791.73	3/4	118.596	1119.2	3/4	137.445	1503.3
7/8	100.138	797.98	7/8	118.988	1126.7	7/8	137.837	1511.9
32	100.531	804.25	38	119.381	1134.1	44	138.230	1520.5
1/8	100.924	810.54	1/8	119.773	1141.6	1/8	138.623	1529.2
1/4	101.316	816.86	1/4	120.166	1149.1	1/4	139.015	1537.9
3/8	101.709	823.21	3/8	120.559	1156.6	3/8	139.408	1546.6
1/2	102.102	829.58	1/2	120.951	1164.2	1/2	139.801	1555.3
5/8	102.494	835.97	5/8	121.344	1171.7	5/8	140.194	1564.0
3/4	102.887	842.39	3/4	121.737	1179.3	3/4	140.586	1572.8
7/8	103.280	848.83	7/8	122.129	1186.9	7/8	140.979	1581.6
33	103.673	855.30	39	122.522	1194.6	45	141.372	1590.4
1/8	104.065	861.79	1/8	122.915	1202.3	1/8	141.764	1599.3
1/4	104.458	868.31	1/4	123.308	1210.0	1/4	142.157	1608.2
3/8	104.851	874.85	3/8	123.700	1217.7	3/8	142.550	1617.0
1/2	105.243	881.41	1/2	124.093	1225.4	1/2	142.942	1626.0
5/8	105.636	888.00	5/8	124.486	1233.2	5/8	143.335	1684.9
3/4	106.029	894.62	3/4	124.878	1241.0	3/4	143.728	1643.9
7/8	106.421	901.26	7/8	125.271	1248.8	7/8	144.121	1652.9

AREAS AND CIRCUMF. OF CIRCLES.

Diam. Ins.	*Circumf. Ins.*	*Area Sq. Ins.*	*Diam. Ins.*	*Circumf. Ins.*	*Area Sq. Ins.*	*Diam. Ins.*	*Circumf. Ins.*	*Area Sq. Ins.*
46	144.513	1661.9	52	163.363	2123.7	58	182.212	2642.1
1/8	144.906	1670.9	1/8	163.756	2133.9	1/8	182.605	2653.5
1/4	145.299	1680.0	1/4	164.148	2144.2	1/4	182.998	2664.9
3/8	145.691	1689.1	3/8	164.541	2154.5	3/8	183.390	2676.4
1/2	146.084	1698.2	1/2	164.934	2164.8	1/2	183.783	2687.8
5/8	146.477	1707.4	5/8	165.326	2175.1	5/8	184.176	2699.3
3/4	146.869	1716.5	3/4	165.719	2185.4	3/4	184.569	2710.9
7/8	147.262	1725.7	7/8	166.112	2195.8	7/8	184.961	2722.4
47	147.655	1734.9	53	166.504	2206.2	59	185.354	2734.0
1/8	148.048	1744.2	1/8	166.897	2216.6	1/8	185.747	2745.6
1/4	148.440	1753.5	1/4	167.290	2227.0	1/4	186.139	2757.2
3/8	148.833	1762.7	3/8	167.683	2237.5	3/8	186.532	2768.8
1/2	149.226	1772.1	1/2	168.075	2248.0	1/2	186.925	2780.5
5/8	149.618	1781.4	5/8	168.468	2258.5	5/8	187.317	2792.2
3/4	150.011	1790.8	3/4	168.861	2269.1	3/4	187.710	2803.9
7/8	150.404	1800.1	7/8	169.253	2279.6	7/8	188.103	2815.7
48	150.796	1809.6	54	169.646	2290.2	60	188.496	2827.4
1/8	151.189	1819.0	1/8	170.039	2300.8	1/8	188.888	2839.2
1/4	151.582	1828.5	1/4	170.431	2311.5	1/4	189.281	2851.0
3/8	151.975	1837.9	3/8	170.824	2322.1	3/8	189.674	2862.9
1/2	152.367	1847.5	1/2	171.217	2332.8	1/2	190.066	2874.8
5/8	152.760	1857.0	5/8	171.609	2343.5	5/8	190.459	2886.6
3/4	153.153	1866.5	3/4	172.002	2354.3	3/4	190.852	2898.6
7/8	153.545	1876.1	7/8	172.395	2365.0	7/8	191.244	2910.5
49	153.938	1885.7	55	172.788	2375.8	61	191.637	2922.5
1/8	154.331	1895.4	1/8	173.180	2386.6	1/8	192.030	2934.5
1/4	154.723	1905.0	1/4	173.573	2397.5	1/4	192.423	2946.5
3/8	155.116	1914.7	3/8	173.966	2408.3	3/8	192.815	2958.5
1/2	155.509	1924.4	1/2	174.358	2419.2	1/2	193.208	2970.6
5/8	155.902	1934.2	5/8	174.751	2430.1	5/8	193.601	2982.7
3/4	156.294	1943.9	3/4	175.144	2441.1	3/4	193.993	2994.8
7/8	156.687	1953.7	7/8	175.536	2452.0	7/8	194.386	3006.9
50	157.080	1963.5	56	175.929	2463.0	62	194.779	3019.1
1/8	157.472	1973.3	1/8	176.322	2474.0	1/8	195.171	3031.3
1/4	157.865	1983.2	1/4	176.715	2485.0	1/4	195.564	3043.5
3/8	158.258	1993.1	3/8	177.107	2496.1	3/8	195.957	3055.7
1/2	158.650	2003.0	1/2	177.500	2507.2	1/2	196.350	3068.0
5/8	159.043	2012.9	5/8	177.893	2518.3	5/8	196.742	3080.3
3/4	159.436	2022.8	3/4	178.285	2529.4	3/4	197.135	3092.6
7/8	159.829	2032.8	7/8	178.678	2540.6	7/8	197.528	3104.9
51	160.221	2042.8	57	179.071	2551.8	63	197.920	3117.2
1/8	160.614	2052.8	1/8	179.463	2563.0	1/8	198.313	3129.6
1/4	161.007	2062.9	1/4	179.856	2574.2	1/4	198.706	3142.0
3/8	161.399	2073.0	3/8	180.249	2585.4	3/8	199.098	3154.5
1/2	161.792	2083.1	1/2	180.642	2596.7	1/2	199.491	3166.9
5/8	162.185	2093.2	5/8	181.034	2608.0	5/8	199.884	3179.4
3/4	162.577	2103.3	3/4	181.427	2619.4	3/4	200.277	3191.9
7/8	162.970	2113.5	7/8	181.820	2630.7	7/8	200.669	3204.4

AREAS AND CIRCUMF. OF CIRCLES.

Diam. Ins.	*Circumf. Ins.*	*Area Sq. Ins.*	*Diam. Ins.*	*Circumf. Ins.*	*Area Sq. Ins.*	*Diam. Ins.*	*Circumf. Ins.*	*Area Sq. Ins.*
64	201.062	3217.0	70	219.911	3848.5	76	238.761	4536.5
1/8	201.455	3229.6	1/8	220.304	3862.2	1/8	239.154	4551.4
1/4	201.847	3242.2	1/4	220.697	3876.0	1/4	239.546	4566.4
3/8	202.240	3254.8	3/8	221.090	3889.8	3/8	239.939	4581.3
1/2	202.633	3267.5	1/2	221.482	3903.6	1/2	240.332	4596.3
5/8	203.025	3280.1	5/8	221.875	3917.5	5/8	240.725	4611.4
3/4	203.418	3292.8	3/4	222.268	3931.4	3/4	241.117	4626.4
7/8	203.811	3305.6	7/8	222.660	3945.3	7/8	241.510	4641.5
65	204.204	3318.3	71	223.053	3959.2	77	241.903	4656.6
1/8	204.596	3331.1	1/8	223.446	3973.1	1/8	242.295	4671.8
1/4	204.989	3343.9	1/4	223.838	3987.1	1/4	242.688	4686.9
3/8	205.382	3356.7	3/8	224.231	4001.1	3/8	243.081	4702.1
1/2	205.774	3369.6	1/2	224.624	4015.2	1/2	243.473	4717.3
5/8	206.167	3382.4	5/8	225.017	4029.2	5/8	243.866	4732.5
3/4	206.560	3395.3	3/4	225.409	4043.3	3/4	244.259	4747.8
7/8	206.952	3408.2	7/8	225.802	4057.4	7/8	244.652	4763.1
66	207.345	3421.2	72	226.195	4071.5	78	245.044	4778.4
1/8	207.738	3434.3	1/8	226.587	4085.7	1/8	245.437	4793.7
1/4	208.131	3447.2	1/4	226.980	4099.8	1/4	245.830	4809.0
3/8	208.523	3460.2	3/8	227.373	4114.0	3/8	246.222	4824.4
1/2	208.916	3473.2	1/2	227.765	4128.2	1/2	246.615	4839.8
5/8	209.309	3486.3	5/8	228.158	4142.5	5/8	247.008	4855.2
3/4	209.701	3499.4	3/4	228.551	4156.8	3/4	247.400	4870.7
7/8	210.094	3512.5	7/8	228.944	4171.1	7/8	247.793	4886.2
67	210.487	3525.7	73	229.336	4185.4	79	248.186	4901.7
1/8	210.879	3538.8	1/8	229.729	4199.7	1/8	248.579	4917.2
1/4	211.272	3552.0	1/4	230.122	4214.1	1/4	248.971	4932.7
3/8	211.665	3565.2	3/8	230.514	4228.5	3/8	249.364	4948.3
1/2	212.058	3578.5	1/2	230.907	4242.9	1/2	249.757	4963.9
5/8	212.450	3591.7	5/8	231.300	4257.4	5/8	250.149	4979.5
3/4	212.843	3605.0	3/4	231.692	4271.8	3/4	250.542	4995.2
7/8	213.236	3618.3	7/8	232.085	4286.3	7/8	250.935	5010.9
68	213.628	3631.7	74	232.478	4300.8	80	251.327	5026.5
1/8	214.021	3645.0	1/8	232.871	4315.4	1/8	251.720	5042.3
1/4	214.414	3658.4	1/4	233.263	4329.9	1/4	252.113	5058.0
3/8	214.806	3671.8	3/8	233.656	4344.5	3/8	252.506	5073.8
1/2	215.199	3685.2	1/2	234.049	4359.2	1/2	252.898	5089.6
5/8	215.592	3698.7	5/8	234.441	4373.8	5/8	253.291	5105.4
3/4	215.984	3712.2	3/4	234.834	4388.5	3/4	253.684	5121.2
7/8	216.377	3725.7	7/8	235.227	4403.1	7/8	254.076	5137.1
69	216.770	3739.3	75	235.619	4417.9	81	254.469	5153.0
1/8	217.163	3752.8	1/8	236.012	4432.6	1/8	254.862	5168.9
1/4	217.555	3766.4	1/4	236.405	4447.4	1/4	255.254	5184.9
3/8	217.948	3780.0	3/8	236.798	4462.2	3/8	255.647	5200.8
1/2	218.341	3793.7	1/2	237.190	4477.0	1/2	256.040	5216.8
5/8	218.733	3807.3	5/8	237.583	4491.8	5/8	256.433	5232.8
3/4	219.126	3821.0	3/4	237.976	4506.7	3/4	256.825	5248.9
7/8	219.519	3834.7	7/8	238.368	4521.5	7/8	257.218	5264.9

AREAS AND CIRCUMF. OF CIRCLES.

Diam. Ins.	*Circumf. Ins.*	*Area Sq. Ins.*	*Diam. Ins.*	*Circumf. Ins.*	*Area Sq. Ins.*	*Diam. Ins.*	*Circumf. Ins.*	*Area. Sq. Ins.*
82	257.611	5281.0	88	276.460	6082.1	94	295.310	6939.8
1/8	258.003	5297.1	1/8	276.853	6099.4	1/8	295.702	6958.2
1/4	258.396	5313.3	1/4	277.246	6116.7	1/4	296.095	6976.7
3/8	258.789	5329.4	3/8	277.638	6134.1	3/8	295.488	6995.3
1/2	259.181	5345.6	1/2	278.031	6151.4	1/2	296.881	7013.8
5/8	259.574	5361.8	5/8	278.424	6168.8	5/8	297.273	7032.4
3/4	259.967	5378.1	3/4	278.816	6186.2	3/4	297.666	7051.0
7/8	260.359	5394.3	7/8	279.209	6203.7	7/8	298.059	7069.6
83	260.752	5410.6	89	279.602	6221.1	95	298.451	7088.2
1/8	261.145	5426.9	1/8	279.994	6238.6	1/8	298.844	7106.9
1/4	261.538	5443.3	1/4	280.387	6256.1	1/4	299.237	7125.6
3/8	261.930	5459.6	3/8	280.780	6273.7	3/8	299.629	7144.3
1/2	262.323	5476.0	1/2	281.173	6291.2	1/2	300.022	7163.0
5/8	262.716	5492.4	5/8	281.565	6308.8	5/8	300.415	7181.8
3/4	263.108	5508.8	3/4	281.958	6326.4	3/4	300.807	7200.6
7/8	263.501	5525.3	7/8	282.351	6344.1	7/8	301.200	7219.4
84	263.894	5541.8	90	282.743	6361.7	96	301.593	7238.2
1/8	264.286	5558.3	1/8	283.136	6379.4	1/8	301.986	7257.1
1/4	264.679	5574.8	1/4	283.529	6397.1	1/4	302.378	7276.0
3/8	265.072	5591.4	3/8	283.921	6414.9	3/8	302.771	7294.9
1/2	265.465	5607.9	1/2	284.314	6432.6	1/2	303.164	7313.8
5/8	265.857	5624.5	5/8	284.707	6450.4	5/8	303.556	7332.8
3/4	266.250	5641.2	3/4	285.100	6468.2	3/4	303.949	7351.8
7/8	266.643	5657.8	7/8	285.492	6486.0	7/8	304.342	7370.8
85	267.035	5674.5	91	285.885	6503.9	97	304.734	7389.8
1/8	267.428	5691.2	1/8	286.278	6521.8	1/8	305.127	7408.9
1/4	267.821	5707.9	1/4	286.670	6539.7	1/4	305.520	7428.0
3/8	268.213	5724.7	3/8	287.063	6557.6	3/8	305.913	7447.1
1/2	268.606	5741.5	1/2	287.456	6575.5	1/2	306.305	7466.2
5/8	268.999	5758.3	5/8	287.848	6593.5	5/8	306.698	7485.3
3/4	269.392	5775.1	3/4	288.241	6611.5	3/4	307.091	7504.5
7/8	269.784	5791.9	7/8	288.634	6629.6	7/8	307.483	7523.7
86	270.177	5808.8	92	289.027	6647.6	98	307.876	7543.0
1/8	270.570	5825.7	1/8	289.419	6665.7	1/8	308.269	7562.2
1/4	270.962	5842.6	1/4	289.812	6683.8	1/4	308.661	7581.5
3/8	271.355	5859.6	3/8	290.205	6701.9	3/8	309.054	7600.8
1/2	271.748	5876.5	1/2	290.597	6720.1	1/2	309.447	7620.1
5/8	272.140	5893.5	5/8	290.990	6738.2	5/8	309.840	7639.5
3/4	272.533	5910.6	3/4	291.383	6756.4	3/4	310.232	7658.9
7/8	272.926	5927.6	7/8	291.775	6774.7	7/8	310.625	7678.3
87	273.319	5944.7	93	292.168	6792.9	99	311.018	7697.7
1/8	273.711	5961.8	1/8	292.561	6811.2	1/8	311.410	7717.1
1/4	274.104	5978.9	1/4	292.954	6829.5	1/4	311.803	7736.6
3/8	274.497	5996.0	3/8	293.346	6847.8	3/8	312.196	7756.1
1/2	274.889	6013.2	1/2	293.739	6866.1	1/2	312.588	7775.6
5/8	275.282	6030.4	5/8	294.132	6884.5	5/8	312.981	7795.2
3/4	275.675	6047.6	3/4	294.524	6902.9	3/4	313.374	7814.8
7/8	276.067	6064.9	7/8	294.917	6921.3	7/8	313.767	7834.4
						100	314.159	7854.0

PRODUCT OF FRACTIONS EXPRESSED IN DECIMALS.

0	1	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
1/16	.0625	.0039															
1/8	.1250	.0078	.0156														
3/16	.1875	.0117	.0234	.0351													
1/4	.2500	.0156	.0313	.0469	.0625												
5/16	.3125	.0195	.0391	.0587	.0781	.0977											
3/8	.3750	.0234	.0469	.0705	.0937	.1172	.1406										
7/16	.4375	.0273	.0547	.0823	.1093	.1367	.1641	.1914									
1/2	.5000	.0313	.0625	.0938	.1250	.1562	.1875	.2188	.2500								
9/16	.5625	.0352	.0703	.1056	.1406	.1757	.2110	.2462	.2813	.3164							
5/8	.6250	.0391	.0781	.1172	.1562	.1952	.2343	.2734	.3125	.3516	.3906						
11/16	.6875	.0430	.0859	.1289	.1718	.2148	.2578	.3007	.3438	.3867	.4297	.4727					
3/4	.7500	.0469	.0938	.1406	.1875	.2344	.2813	.3281	.3750	.4219	.4686	.5156	.5625				
13/16	.8125	.0508	.1016	.1523	.2031	.2539	.3047	.3555	.4063	.4570	.5078	.5586	.6094	.6601			
7/8	.8750	.0547	.1094	.1640	.2187	.2734	.3281	.3828	.4375	.4922	.5469	.6016	.6563	.7109	.7656		
15/16	.9375	.0586	.1172	.1757	.2343	.2929	.3515	.4102	.4688	.5274	.5859	.6445	.7031	.7617	.8203	.8789	
1	1.000	.0625	.1250	.1875	.2500	.3125	.3750	.4375	.5000	.5625	.6250	.6875	.7500	.8125	.8750	.9375	1.000

INDEX.

PAGE

ALLOWANCE for upsets on round and square bars 241
for eye, square and round bars 243
ANGLES 10-13
BULB, weights and dimensions of 9
elements and properties of 164
dimensions and weights of 10-13
elements and properties of 166-169
length of legs of, corresponding to given areas 18
as beams, approximate rule for 123-135
as struts 194
moments of inertia 166
radii of gyration 167
cover, dimensions and weights 12
square root, dimensions and weights 12
special, dimensions and weights 12
AREAS and circumferences of circles 251-256
ARCHES, tie rods for 109
AXLES 33

BAR, sizes, iron or steel 16
BAR IRON EXTRAS, eastern classification 17
BAR IRON, weights and areas of round and square 21
BAR STEEL, " " " " " " 21
BEAMS.
BULB, or deck section 9
approximate rule for strength of 123-135
dimensions and weights 9
elements and properties of 162
moments of inertia 162
radii of gyration 162
tables of safe loads and deflections 102
" " and spacing, as floor beams 102
weights of 9
I BEAM SECTIONS.
approximate rules for strength of 123-135
bending moments 126-129
cantilever 124-126
continuous 124-128

PAGE

BEAMS—I Beam Sections.
deflections of 41
dimensions and weights 4
elements and properties of 150–153
factors of safety 39
greatest safe loads 44–97
iron floor 106–108
lateral strength of 110
limits of deflection 43
" safe load 39
maximum load in tons 149–153
moments of inertia 150–152
properties and elements of 150–153
proportions of 4
radii of gyration 150–152
safe load and deflections 44–97
spacing of 44–97
subject to both bending and compression 132
supporting brick walls 119
" irregular loads. 130
unsymmetrical sections 123–135
weights of 2
weight of floor per square foot 107–108
with fixed ends 42
without lateral supports 40
BEAMS AS STRUTS 190–193
BELTING 227
BENDING moments for beams 126–129
BENDING, bearing and shearing values for iron and steel pins 230
BENDING and compression both, beams subject to 132
BENDING, resistance of iron and steel to 37
BOLTS AND NUTS, weight of 246
BRICK ARCHES for floors 109
arches, tie rods for 109
walls, beams for supporting 119
BRIDGE RIVETS, shearing and bearing value of 234
weight of 245
BULB ANGLES, weight of iron and steel 9
BULB PLATES, weights of iron and steel 9
BULB BEAMS (see Beams) 9
BUCKLED PLATES 111
greatest safe loads for 112

CANTILEVER BEAMS. 124–126
CHANNELS, Iron or Steel.
approximate rule for 123
as struts 200

PAGE

CHANNELS, IRON OR STEEL.
dimensions and weights of 5
elements and properties of 154–156
moments of inertia 154–156
proportions of 5
radii of gyration 154 156
safe loads and deflections 98
struts 188
weights of 6
CIRCLES, areas and circumferences of 251–256
CLEVISES, dimensions of 239
dimensions of square rods and pins for 243
COLUMNS, wrought iron 206
radii of gyration for round and square 207
Z bars 160
greatest safe loads for round, of iron and steel 208–211
" " " square " " 212–215
COMPARATIVE efficiencies of iron and steel 37
COMPRESSION, wrought iron in 34
CONTINUOUS beams, iron and steel 42
shafting, working formulæ for 226
CORRUGATED FLOORING 114
weight and strength of 115
loads per square foot 116–118
COVER ANGLES, size and weights of 12
CRANE STRESSES 216

DECIMAL equivalents for vulgar fractions 250
DECIMALS, product of fractions expressed in 257
DECK BEAMS (see Beams). 9
DEFLECTION of beams, iron and steel 41
limits of, for beams 43
tables of, for I beams, of iron and steel 44–97
" channel bars of iron and steel 98–101
" deck beams of iron and steel 102
" Z bars of iron and steel 104
of shafting 225
tables of, for corrugated flooring sections 116–118
DESTRUCTIVE pressures for iron and steel struts, tables of 182–186
DIMENSIONS of I beams 4
channels 5
pins and nuts 232
rivet shanks to form heads 237
eye bars 238
clevises 239
sleeve nuts 240
allowance for upsets as round and square bars 241

PAGE
DIMENSIONS, square rods and pins for clevises 242
separators 244
bolts 246
screw threads 248
working, for continuous shafting 228
DUCTILITY, iron and steel 34–36

EFFICIENCIES, comparative, of iron and steel 37
ELASTICITY of wrought iron and steel 35
ELEMENTS of structural shapes 149
of I beams, iron and steel 150–153
" channels, iron and steel 154–157
" Z bars, iron and steel 158–161
" angles, iron and steel 166–169
" tees, iron and steel 170
" deck beams, iron and steel 162
" bulb angles, iron and steel 164
EXPANSION, by heat, of iron and steel 35
EYE BARS, dimensions of 238

FACTORS of safety for beams 39
of safety for struts 181
" " " shafting 223
FIXED-ENDED, steel or iron struts 180
FLAT BAR IRON, approximate rule for beams of 122
FLAT-ENDED steel or iron struts 180
FLATS, sizes of iron or steel rolled 16
FLEXURE (see Deflection). 41
FLOOR BEAMS 106
rule for weight of 107
spacing of 43
lateral strength of iron and steel 110
weight per square foot, iron and steel I 108
FLOORING, trough-shaped sections for bridges and buildings . . . 115
table of weight and strength, iron and steel 115–118
" " causing deflection of $\frac{1}{400}$ of span 118
FORMULÆ, for unsymmetrical beams 123–135
approximate, for rolled beams 123–135
tables of, for beams of various sections 123–135
FRACTIONS of an inch expressed in decimals 250
product of " " " 257
FLUCTUATING loads, limitations for safe loads 39

GIRDERS, riveted, iron or steel 137
coefficient of strength, rule for determining 138
rule to find safe loads 138

PAGE
GIRDERS, strength and weight for tables 139–147
stresses of 218
GYRATION, radii of 149
for I beams, iron and steel 150–152
" channels, iron and steel 154–156
" Z bars, iron and steel 159
" angles, iron and steel 167–169
" tees, iron and steel 170
" deck beams, iron and steel 162
" bulb angles, iron and steel 164
formulæ for various sections. 178
for round columns, iron and steel 207
" square " " " 207
HALF-ROUND BAR IRON, sizes 16
HEADS of rivets, dimensions of shank required to form 237
HINGED-ENDED steel or iron struts 180
HORSE-POWER of shafting 225

I BEAMS (see Beams).
INERTIA, moments of 172
for I beams, iron and steel 150–152
" angles, " " 166–168
" channels, " " 154–156
" Z bars, " " 159
" tees, " " 171
" deck beams, " " 162
" bulb angles, " " 164
formulæ for various sections 178
for combined sections 174–176
IRON BEAMS.
deflection of 41
greatest safe loads and deflection for, of I beam sections . . . 44–65
" " " " " " of channel bar " . . . 98
" " " " " " of Z bar sections 104
" " " " " " of corrugated floor sections 116
IRON, comparative efficiencies of steel and iron 37
strength of wrought 34
ductility of 34–36
modulus of elasticity 35
resistance to compression 34–38
elasticity of rolled 35
resistance to shearing 222
" " torsion 222
" " bending 227
columns, round and square 206–215
shafting 222
struts 180

PAGE

IRON, sizes of bar 16
weight per lineal foot of bar 21–29
weight per lineal foot of plate 30
weight of sheets of wrought 32
weights and areas of round and square bar 21–29

LATERAL STRENGTH OF FLOOR BEAMS 110
support, beams without 40
LATTICING for channel struts 189–202
LATTICED channel struts, safe loads, iron and steel 202–205
LOADS (see Safe Loads). 39
character of 40

MODULUS OF ELASTICITY of rolled iron and steel 35
resistance for iron and steel 34
rupture for rolled iron and steel 34

NUTS and pins, sizes of 232
NUTS, sleeve, sizes of 240

PINS, shearing, bending and bearing values of iron and steel 230
PINS AND NUTS, table of dimensions 232
PRESSURES, destructive, for iron and steel struts, tables of 182–187
PROPERTIES and elements of I beams, iron and steel 149–153
of channels, iron and steel 154–157
" Z bars, iron and steel 158–161
" angles, iron and steel 166–169
and elements of tees, iron and steel 170
of deck beams, steel and iron 162
" bulb angles, iron and steel 164
PROPORTIONS of I beams 4
of channels 5
" pins and nuts 232
" rivet shank to form head 237
" eye bars 238
" clevises 239
" sleeve nuts 240
" round and square bars to make upset 243
" " " rods and pins for clevises 242
" separators 244
" bolts 246
" screw threads 248
working, for continuous shafting 226–229

RADIUS of GYRATION, for round columns, iron and steel 207
I beams, iron and steel 150–153

PAGE
RADIUS of GYRATION, channel bars, iron and steel 154–157
Z bars, iron and steel 158–161
tees, iron and steel 170
angles, iron and steel 166–169
deck beams, iron and steel 162
bulb angles 164
square columns, iron and steel 206–212
formulæ for various sections 178
RIVETED GIRDERS, iron or steel 137–147
coefficient of strength, rule for determining 137–148
rule to find safe loads 138
strength and weight for, tables 139–147
stresses of 216–219
RIVETS, weights of bridge 245
shearing and bearing value of 234
ROOF STRESSES 219–221
ROUND BAR IRON, sizes 16
weights and area 21–23
approximate rule for beams of 123–135
ROUND COLUMNS, table of radii of gyration for 207
" " greatest safe loads, iron and steel . . . 208–211
ROUND-ENDED steel or iron struts 180
RULE for weight of rolled iron 35
for weight of iron in floor beams 107
" thrust of brick arches 109
" lateral strength of I beams, iron and steel 110
" " " " channel bars, iron and steel 110
" beams, bearing irregular loads 130
RULES, approximate, for moments of inertia 178
for radii of gyration 178
for shafting 222–224

SAFE LOADS, coefficient for 42–124
limits of, for beams 39
greatest for beams 39
" " I beams, iron and steel 44–97
" " deck beams, iron and steel 102
" " channel bars, iron and steel 98–101
" " corrugated flooring, iron and steel 116–118
" " iron struts, tables of 183
" " steel " " " 185–187
for struts of I beams, tables of 190–193
" " channel bars, tables of 200–205
" " angles, tables of 194
" " tees, tables of 198
for square columns, iron, tables of 212
" " " steel. " 214

PAGE

SAFE LOADS, for round columns, iron, tables of 208
for round columns, steel, tables of 210
SCREW THREADS, table of standard 248
SHAFTING, sizes rolled (see also Rounds) 16
rules for determining sizes and lengths 222–224
iron or steel 222
deflection of 225
horse-power of 225
working formulæ for continuous 225
" proportions " 228
SHAPES, miscellaneous, dimensions and weights 15
SHEARING strength of iron and steel 222
SHEARING, bending and bearing values of iron or steel pins 230
and bearing values of bridge rivets 234
SHANKS required to form head of rivets 237
SLEEVE-NUTS, sizes of 240
SPACING floor beams of I beam sections, iron and steel 44–97
deck beam sections, iron and steel 102
channel bars, iron and steel 98–101
Z bars, iron and steel 104
SPECIFIC GRAVITY, iron and steel 35
SQUARE bar iron and steel sizes 16
" " weights and areas 21–23
SQUARE-ROOT ANGLES, weights of, iron and steel 12

STEEL.

Elasticity of Rolled 35
Elastic Limit 34
modulus of elasticity 35
ductility 34–36
expansion by heat 35
specific gravity 35
structural 36
physical properties of open hearth 36
comparatlve efficiencies of iron and 37
for beams 37
for struts 38
for shafting 222
sizes of bar 16
weight and area of round and square bar 21–32
" of sheets of rolled 32
columns, round and square 206–214
shafting 222
weight per lineal foot of bar 21-29
struts 180–187
resistance to compression 34
strength of 34
tensile and compression tests 34–180

PAGE

STEEL, resistance to shearing 222
" " torsion 222
" " bending 37
strength of, in compression 34
" " in torsion 38
" " transverse 37
STEEL BEAMS 3
deflection of 41
greatest safe loads for and deflections of I beam sections . . 44–97
" " " " " channel bar sections 98–101
" " " " " Z bar sections 104
" " " " " corrugated floor sections 116
STRENGTH OF WROUGHT IRON AND STEEL in compression . . . 34
in tension 34
in shearing 38
STRESSES in framed structures 216
STRUCTURAL STEEL 36
STRUTS of rolled iron and steel 180
factors of safety for 181
tables of destructive pressures for, of iron and steel . . . 182–186
tables of greatest safe loads for, of iron or steel 183–187
" " " " for I beam sections 190–193
" " " " of channel sections 200–205
" " " " of angle sections 194
" " " " of tee sections 198
flat-ended, steel or iron 180
fixed-ended, steel or iron 180
hinged-ended, steel or iron 180
round-ended, steel or iron 180
SEPARATORS, table of standard 244

TEES, dimensions and weights of 14
elements of even-legged 170
" uneven-legged 171
as struts, tables of greatest safe loads 198
radii of gyration 179
moments of inertia 170
approximate rule for beams of 123–135
TENSION in wrought iron 34
in steel 34
of belting 227
TIE RODS for brick arches 109
TORSIONAL strength of iron and steel 222
THREADS, sizes of standard screw threads 248

ULTIMATE loads for iron and steel struts 182–186

PAGE

WEIGHTS of angles 10–13
bar iron and steel 24–29
bars, round and square 21–23
I beams 2
bolts and nuts 246
bridge rivets 245
bulb angles 9
bulb plates 9
channels 6
carbuilders' channels 15
deck beams 9
flooring, corrugated 116
rivets, bridge 245
rivet heads 245
sheets, iron and steel 32
Z bars 8

Z BARS, dimensions and weights 8
elements and properties of 158
as struts, tables of greatest safe loads 196
columns 160

SECTIONS OF
IRON AND STEEL
ROLLED AT
PENCOYD.

Plates 1, 2, 3, 7, 8, 9, 25 and 26 are $\frac{1}{4}$ size
Plate 35 is $\frac{1}{6}$ size
All others are $\frac{1}{3}$ size.
For Sections rolled of either
IRON OR STEEL the weights given are for IRON.

If rolled of Steel the weights are
two per cent greater than for Iron.

For shapes rolled of Steel only
the weights are for Steel.

NOTICE.

Several sections marked "Steel" or "Iron"
may be rolled in either metal
subject to special arrangement.

ALL WEIGHTS ARE GIVEN IN POUNDS PER FOOT

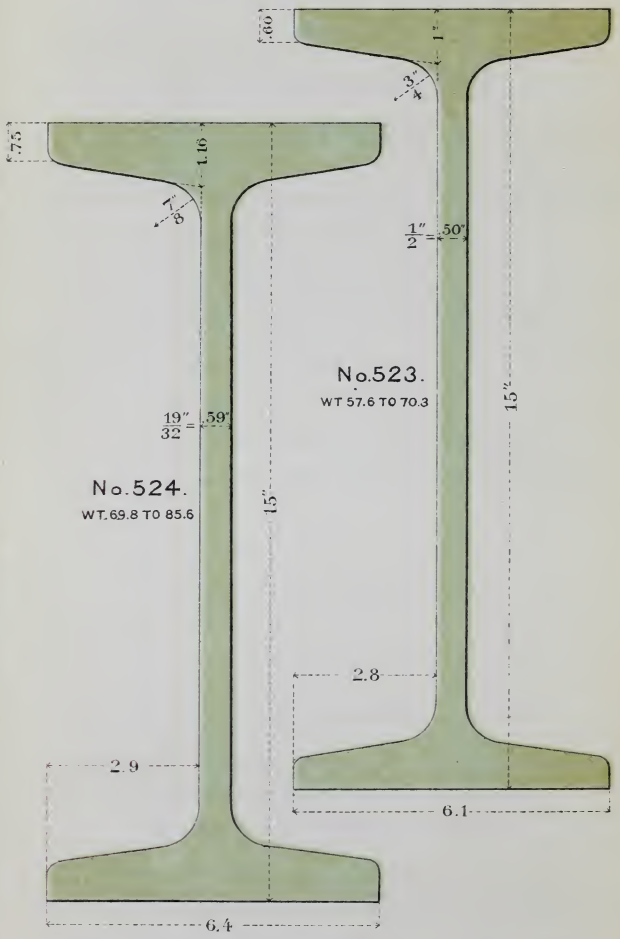
LEAST SIZE OF EACH SECTION GIVEN

JULIUS BIEN & CO. LITH. N.Y.

Plate No. 1.

STEEL

All weights given in pounds per foot



STEEL

All weights given in pounds per foot

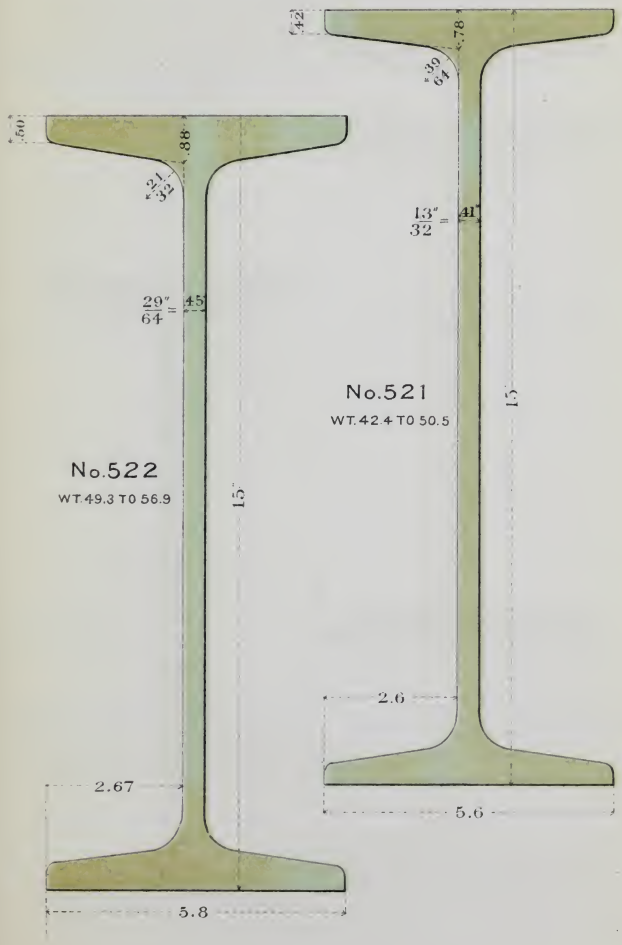
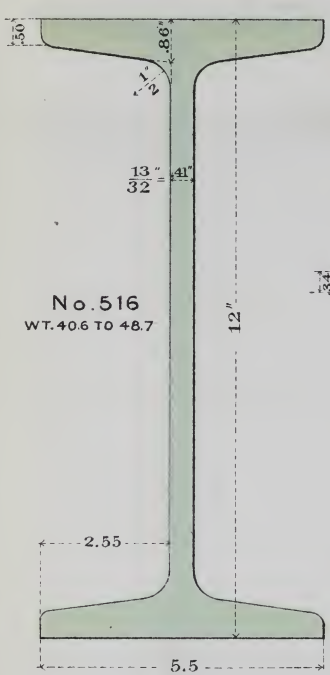


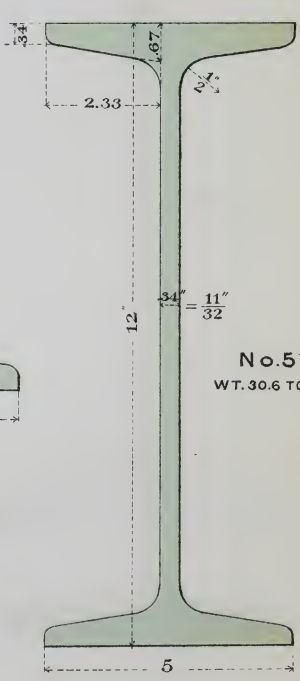
Plate No.3.

STEEL

All weights given in pounds per foot.



No.516
WT. 40.6 TO 48.7



No.515
WT. 30.6 TO 37.0

STEEL

All weights given in pounds per foot.

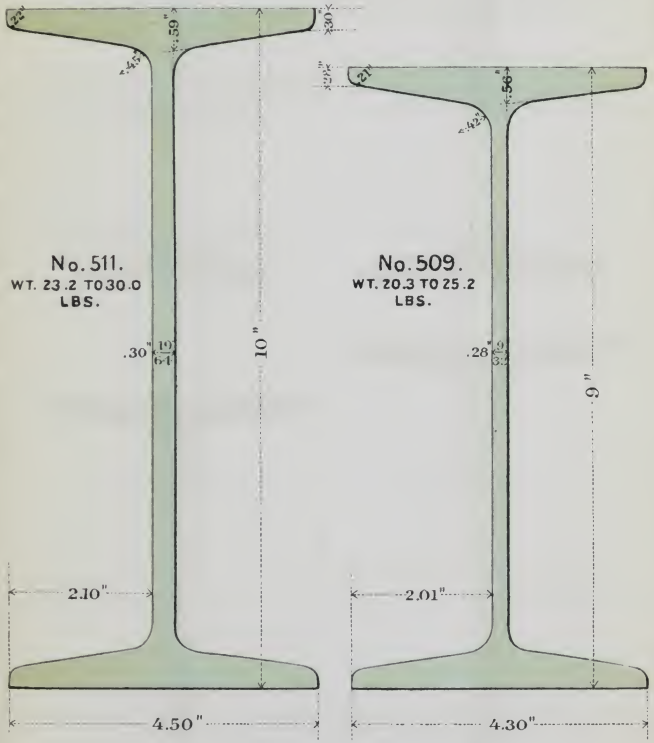
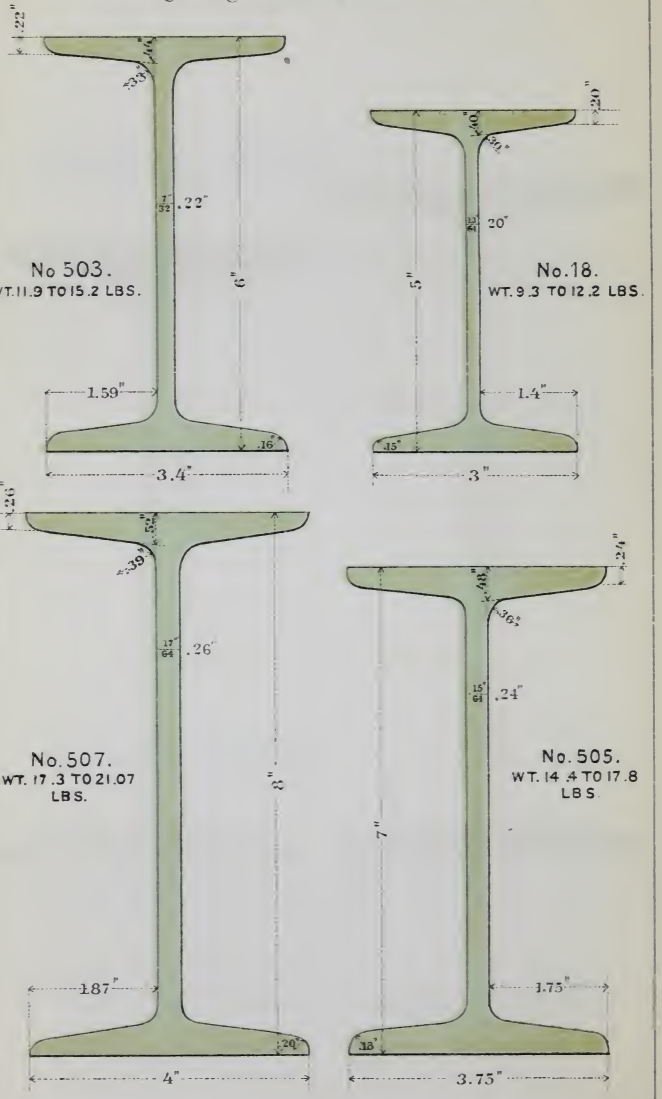


Plate No. 5.

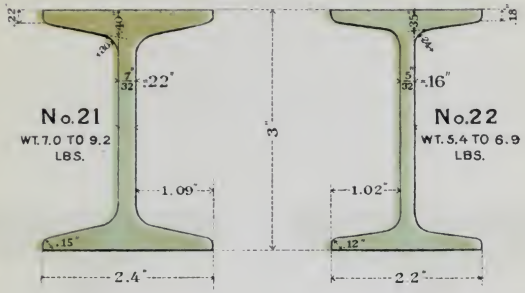
STEEL

All weights given in pounds per foot



STEEL

All weights given in pounds per foot



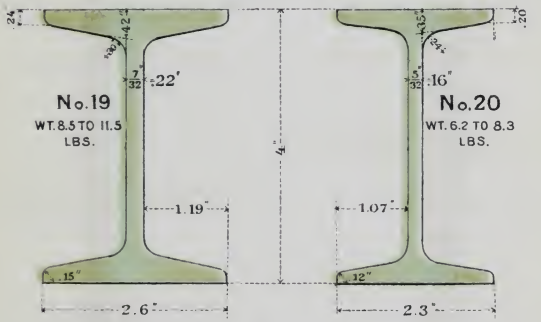
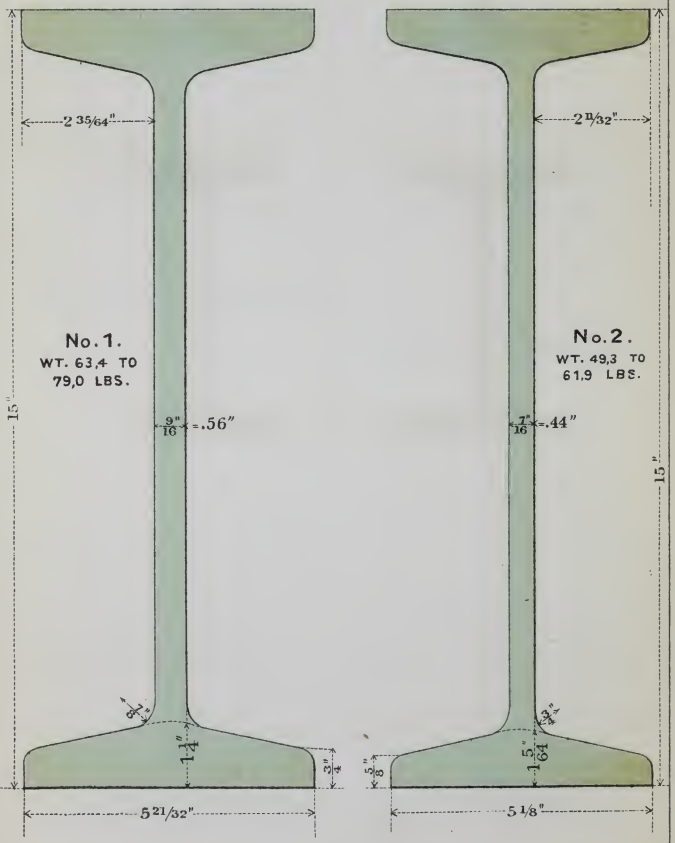


Plate No. 7.

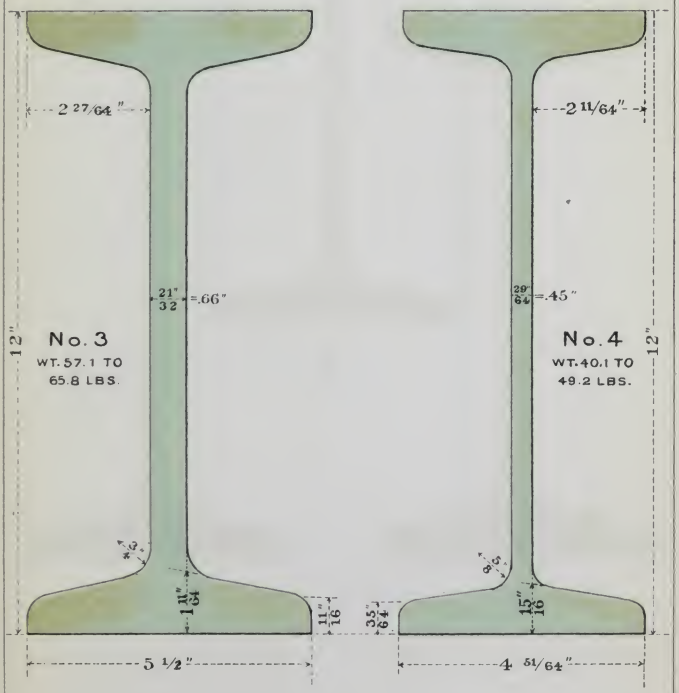
IRON

All weights given in pounds per foot.



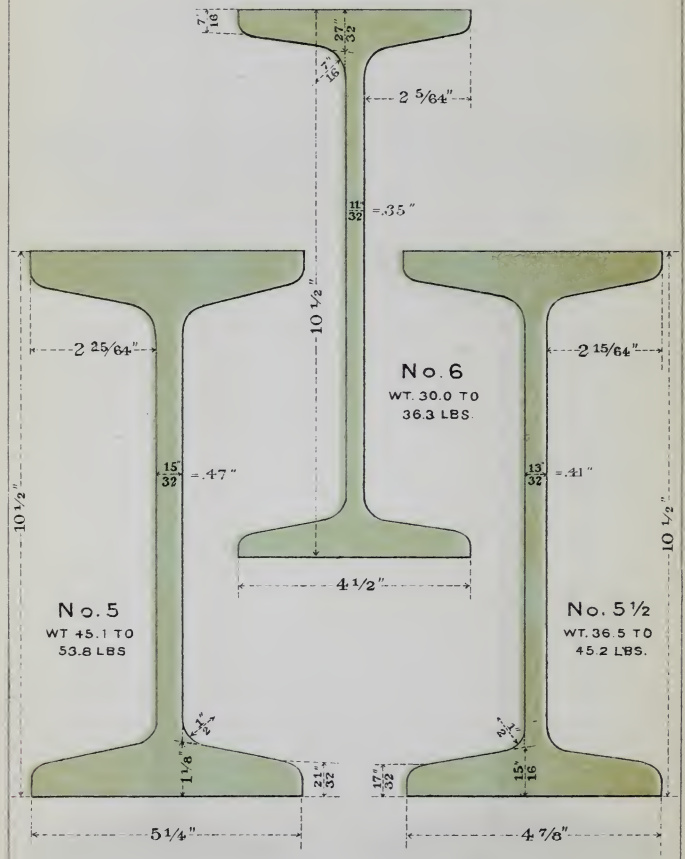
IRON OR STEEL

All weights given in lbs. per ft. for Iron. For Steel add 2 per cent.



IRON OR STEEL

All weights given in lbs per ft. for Iron. For Steel add 2 per cent.



IRON OR STEEL

All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent

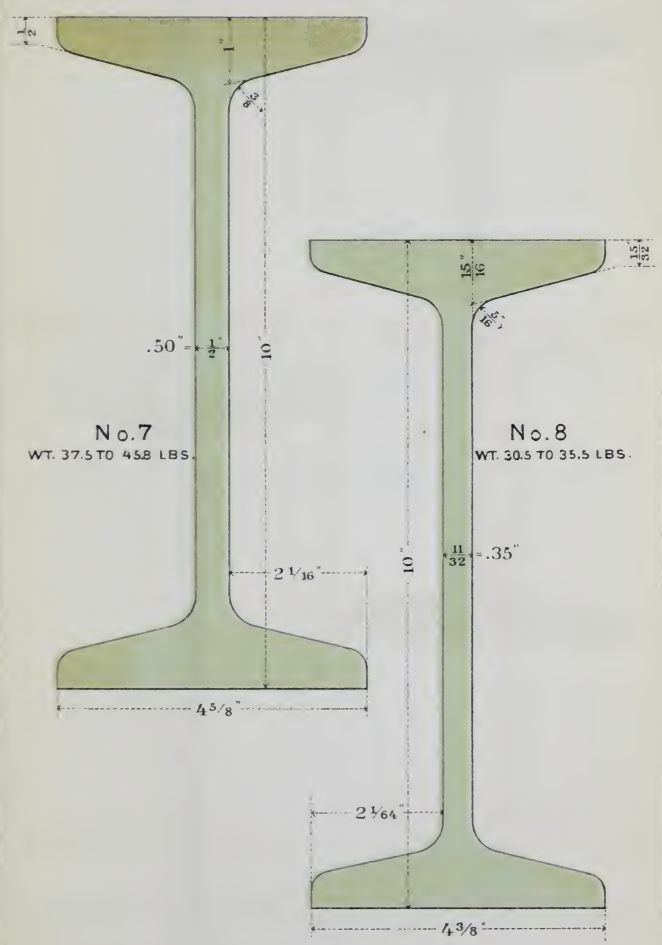
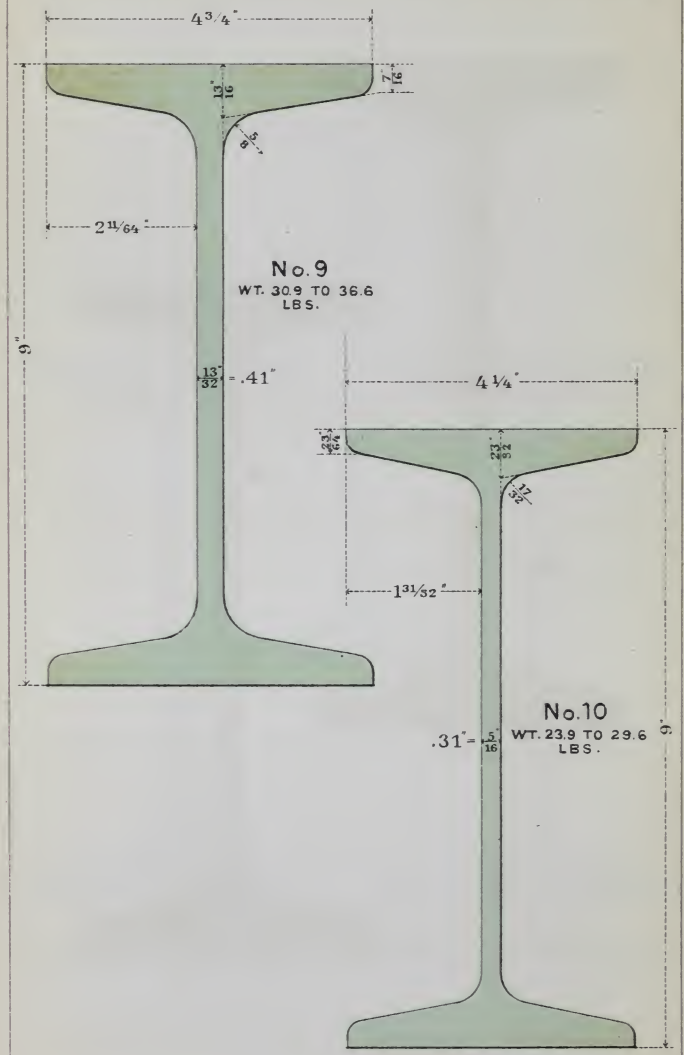


Plate No.11

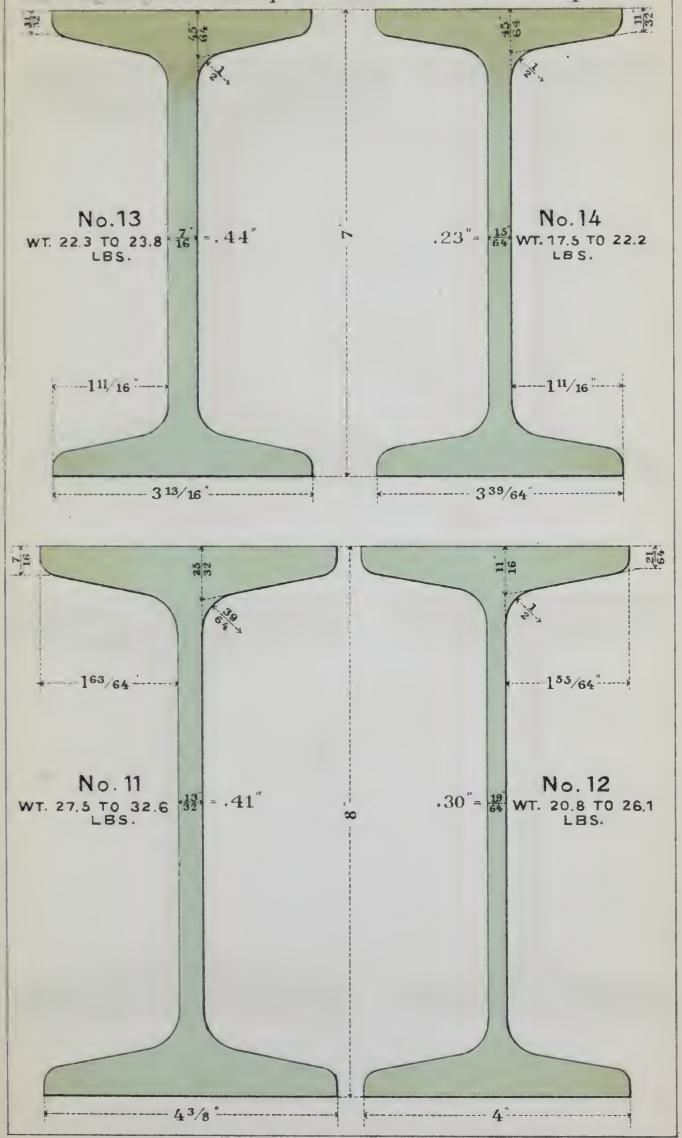
IRON OR STEEL

All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent



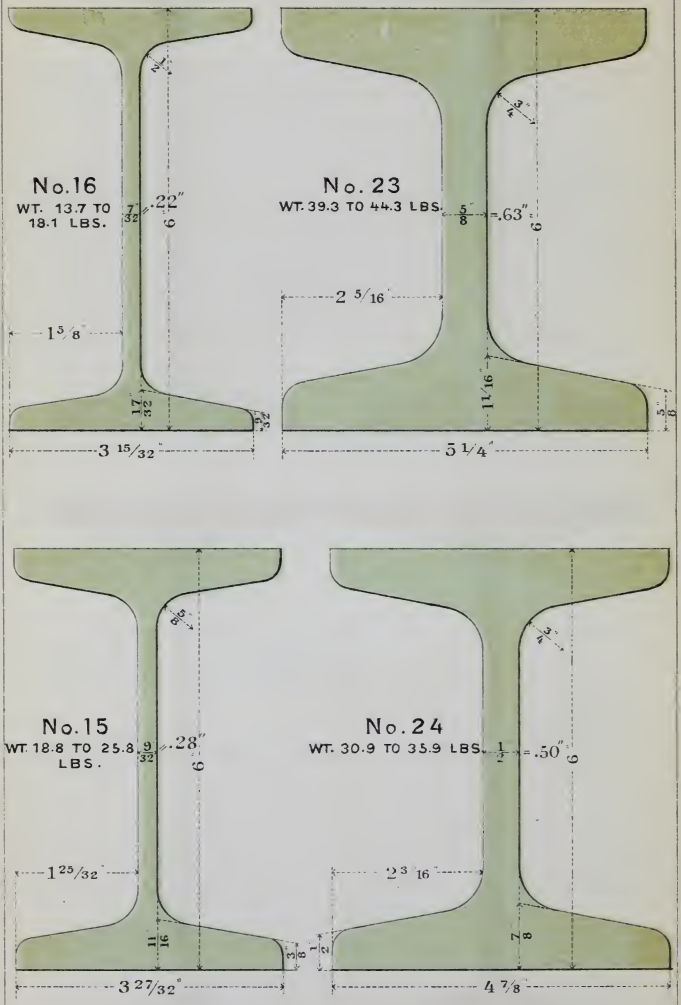
IRON OR STEEL

All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent



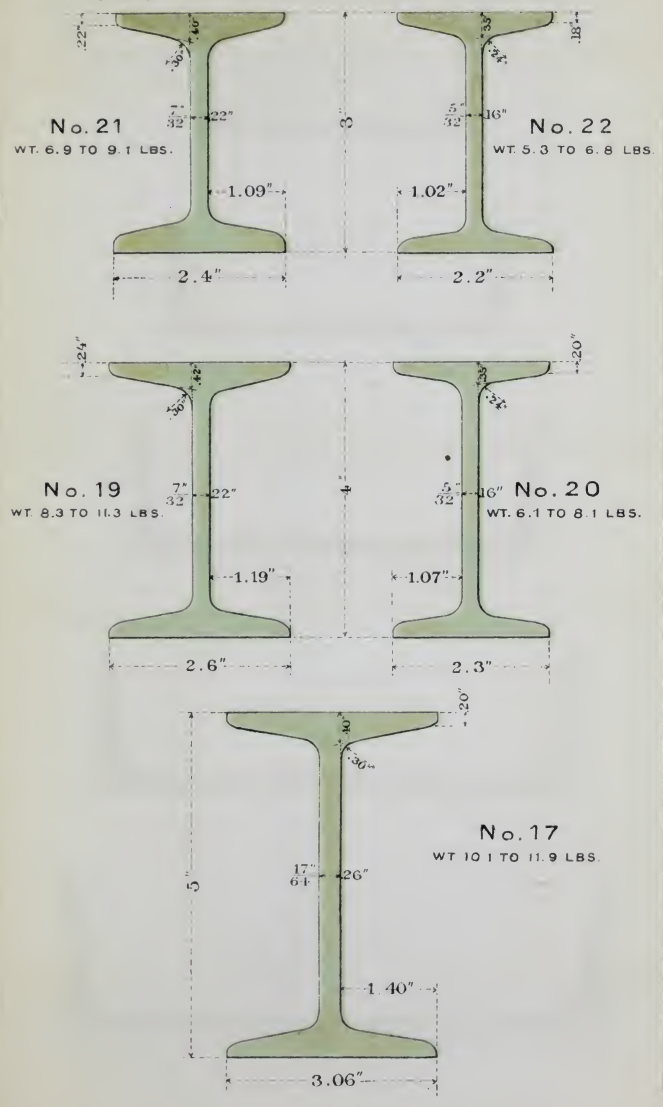
IRON OR STEEL

All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent



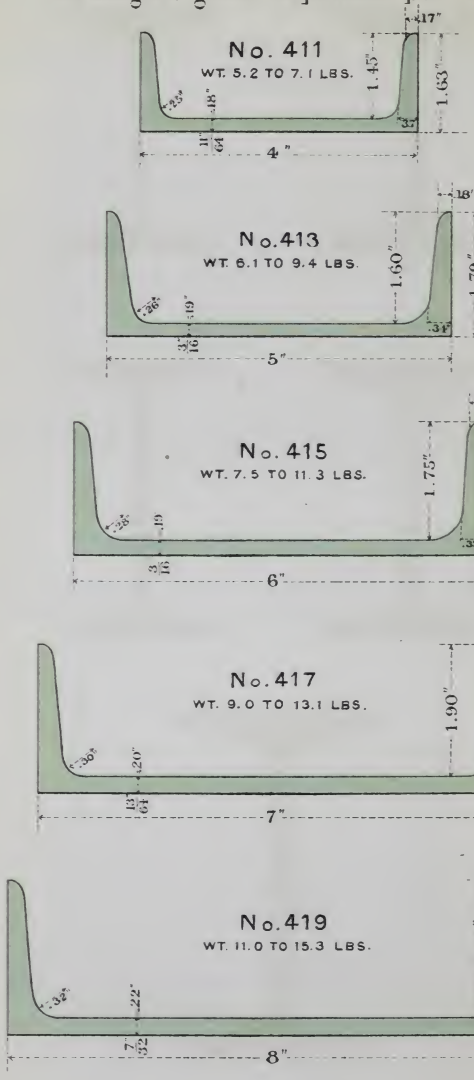
IRON OR STEEL

All weights given in lbs. per ft for Iron. For Steel add 2 per cent.



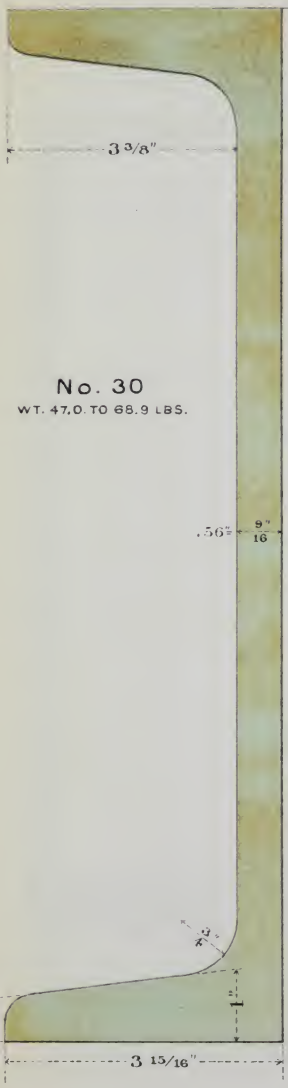
STEEL

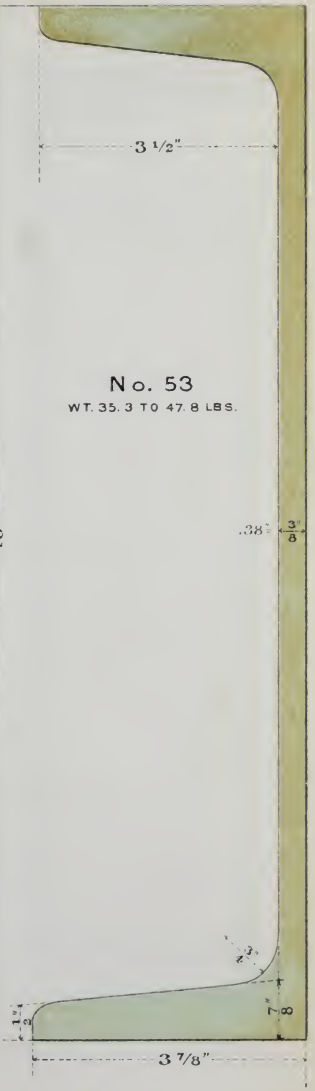
All weights given in pounds per foot.



IRON OR STEEL

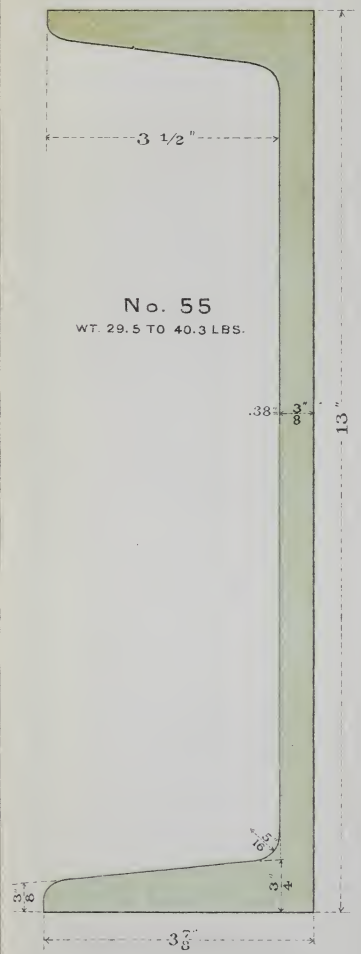
All weights given in lbs. per ft. for Iron. For Steel add 2 per cent.

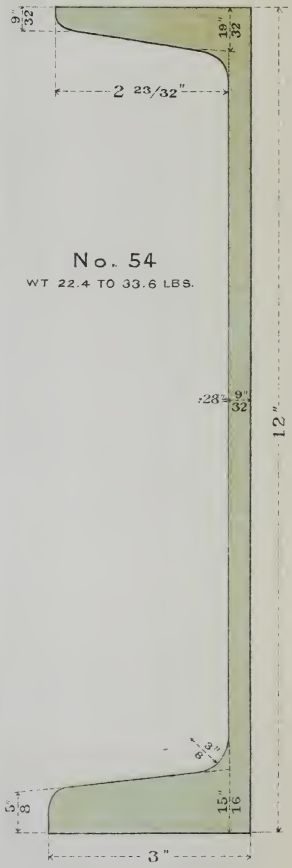




IRON OR STEEL

All weights given in lbs per ft. for Iron. For Steel add 2 per cent.





IRON OR STEEL

All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent.

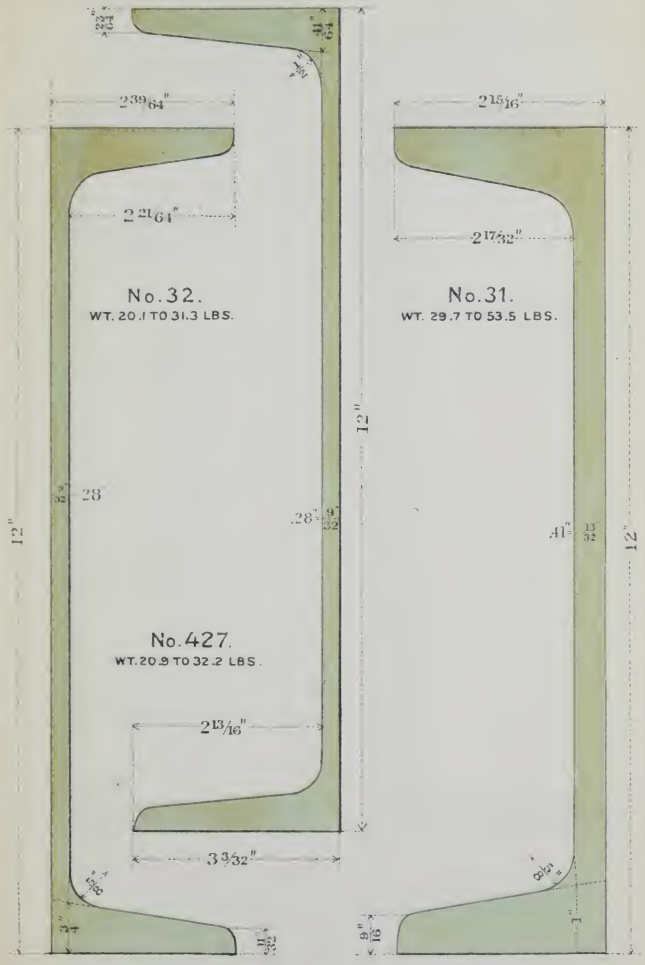
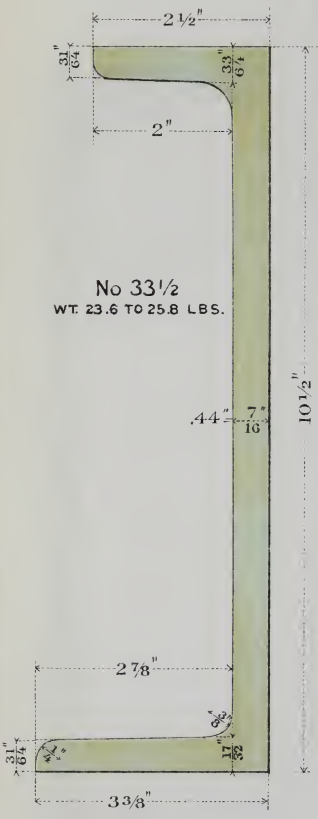
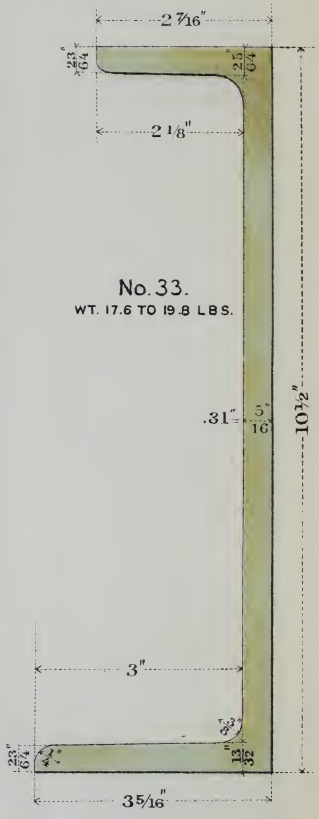


Plate No. 19.

IRON OR STEEL

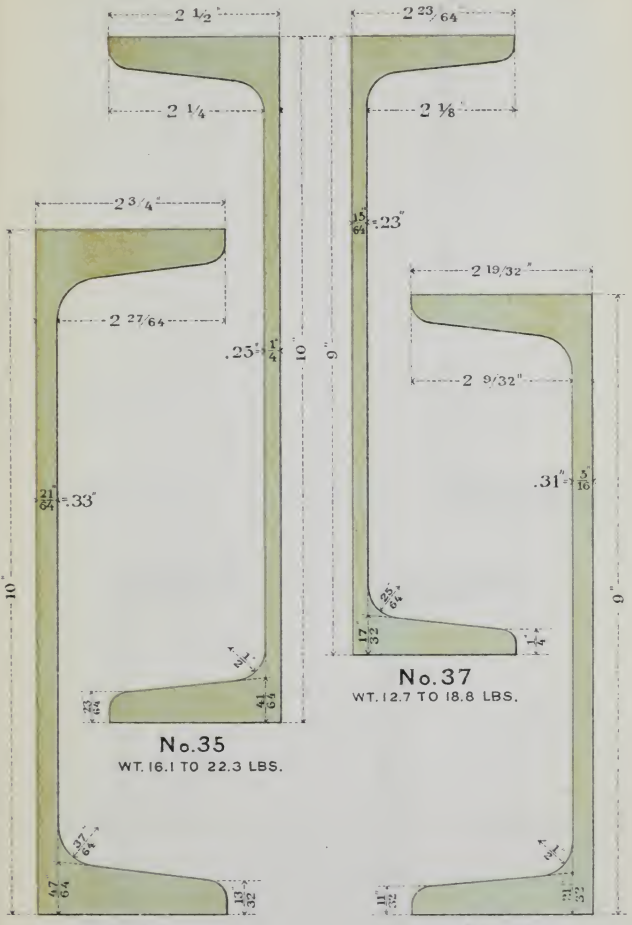
All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent.





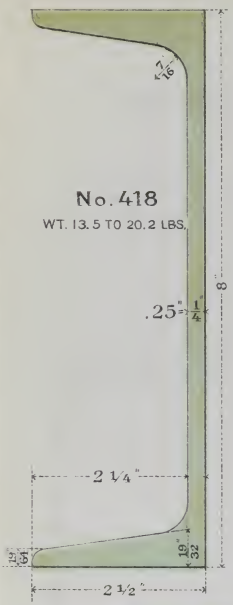
IRON OR STEEL

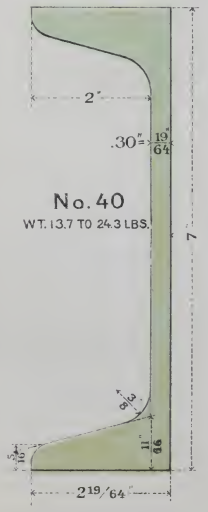
All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent

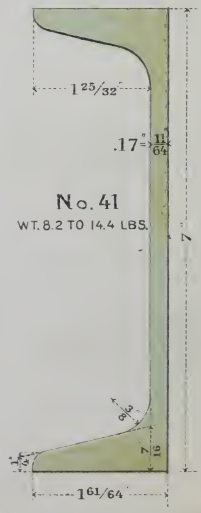


IRON OR STEEL

All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent

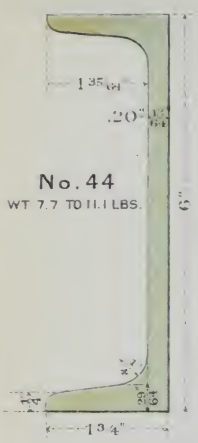


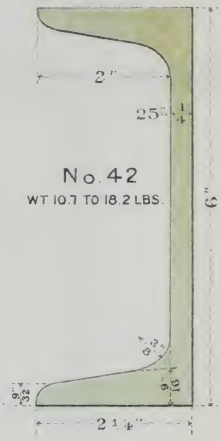


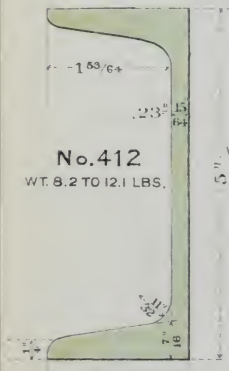


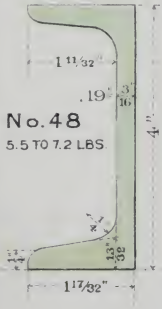
IRON OR STEEL

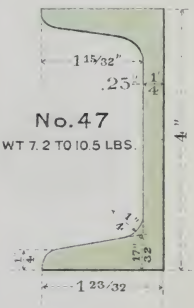
All weights given in lbs. per ft. for Iron. For Steel add 2 per cent.

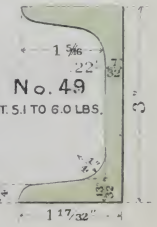


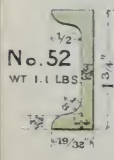


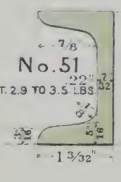












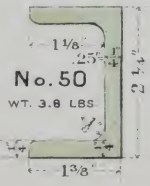
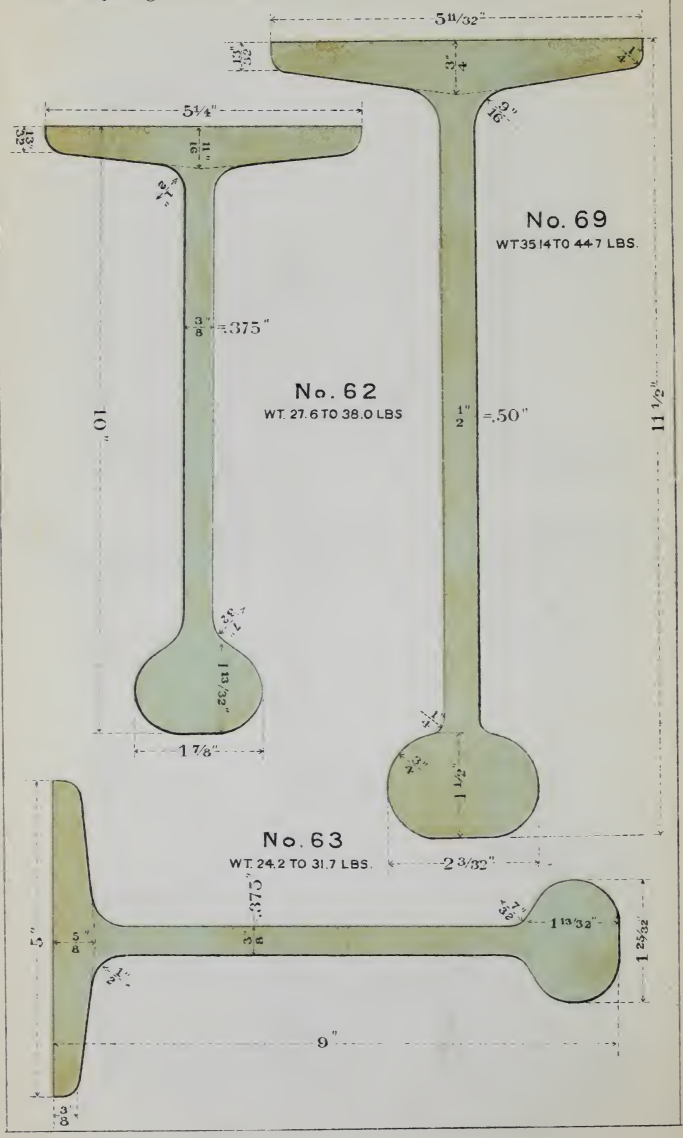


Plate No. 23.

IRON OR STEEL

All weights given in lbs. per ft. for Iron For Steel add 2 per cent.



IRON OR STEEL

All weights given in lbs. per ft. for Iron. For Steel add 2 per cent.

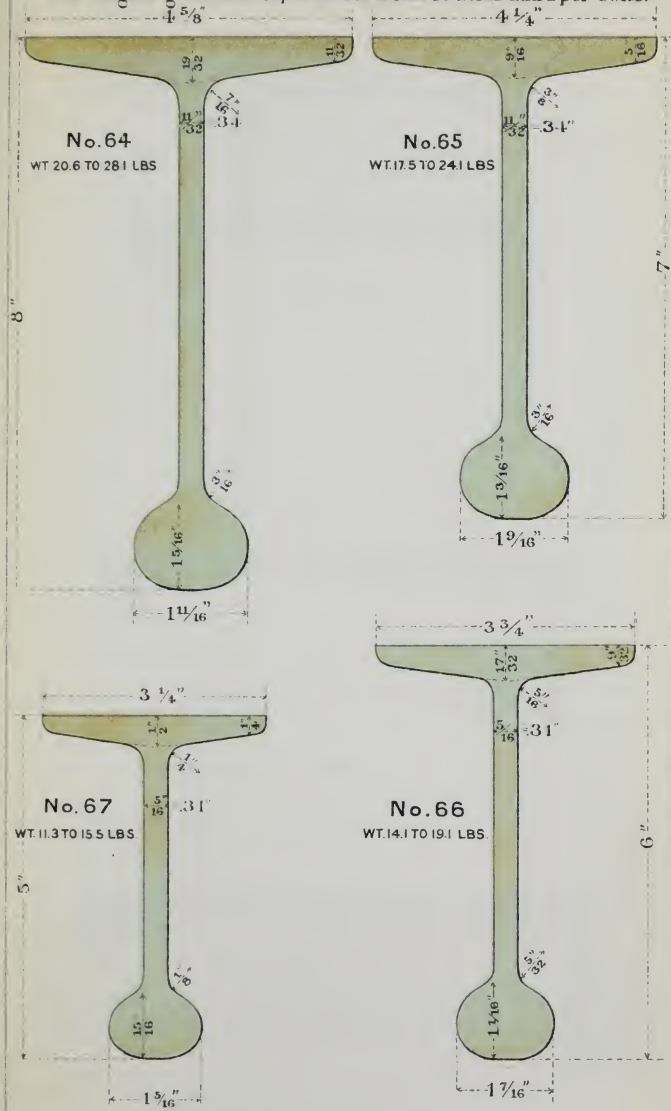
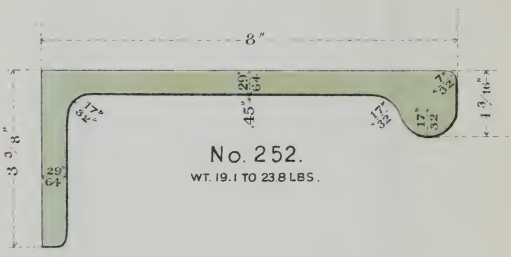
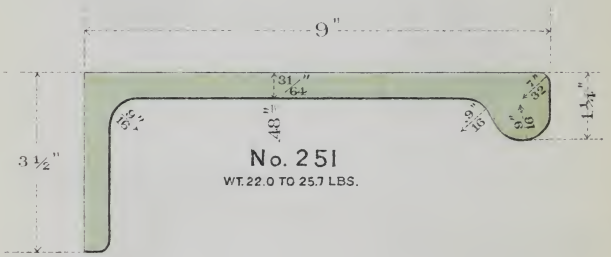


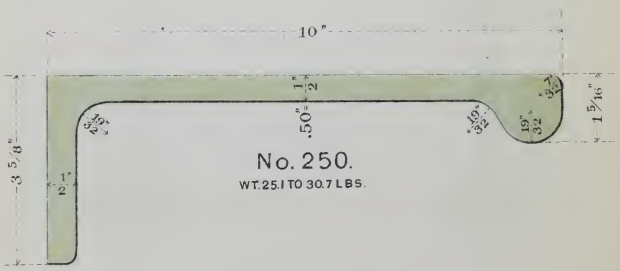
Plate No. 25.

IRON OR STEEL

All weights given in lbs. per ft. for Iron For Steel add 2 per cent

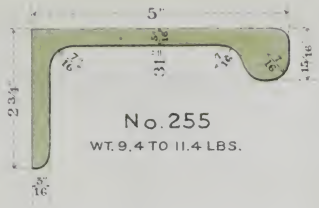


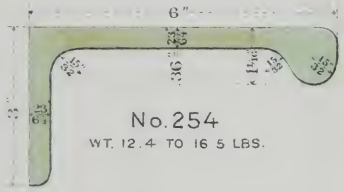


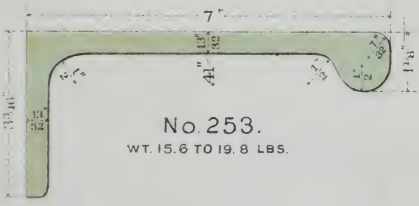


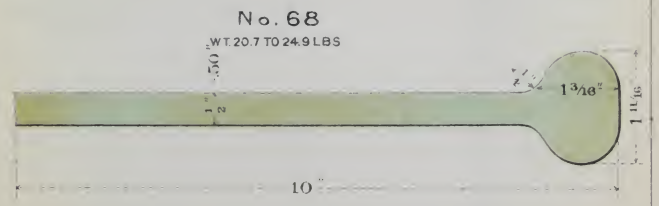
IRON OR STEEL

All weights given in lbs. per f't. for Iron. For Steel add 2 per cent.



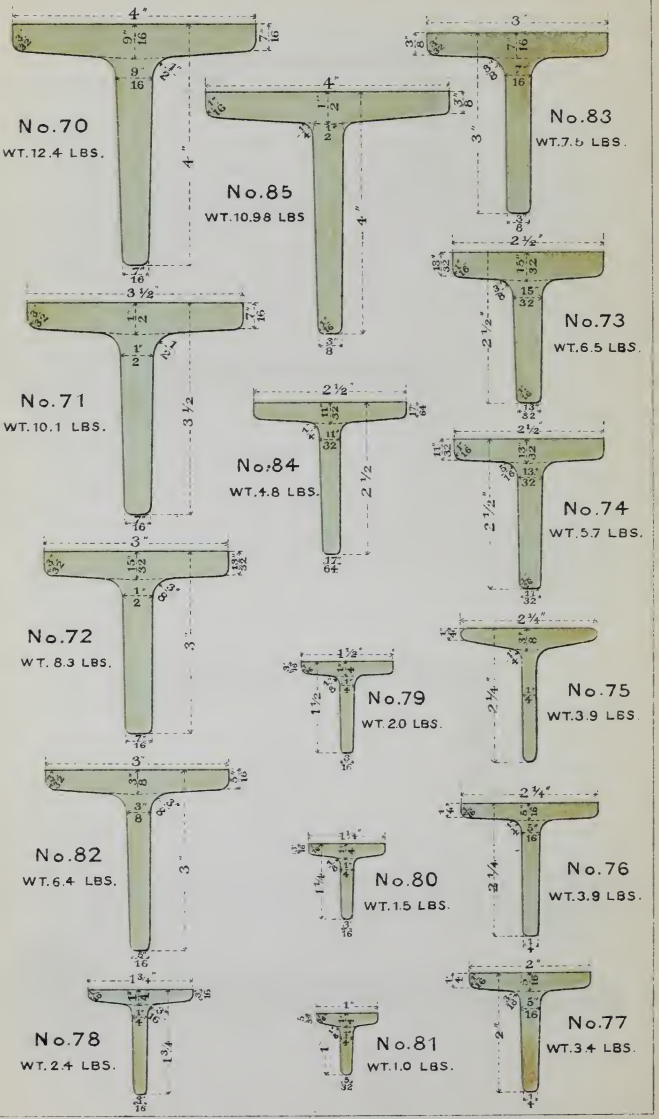






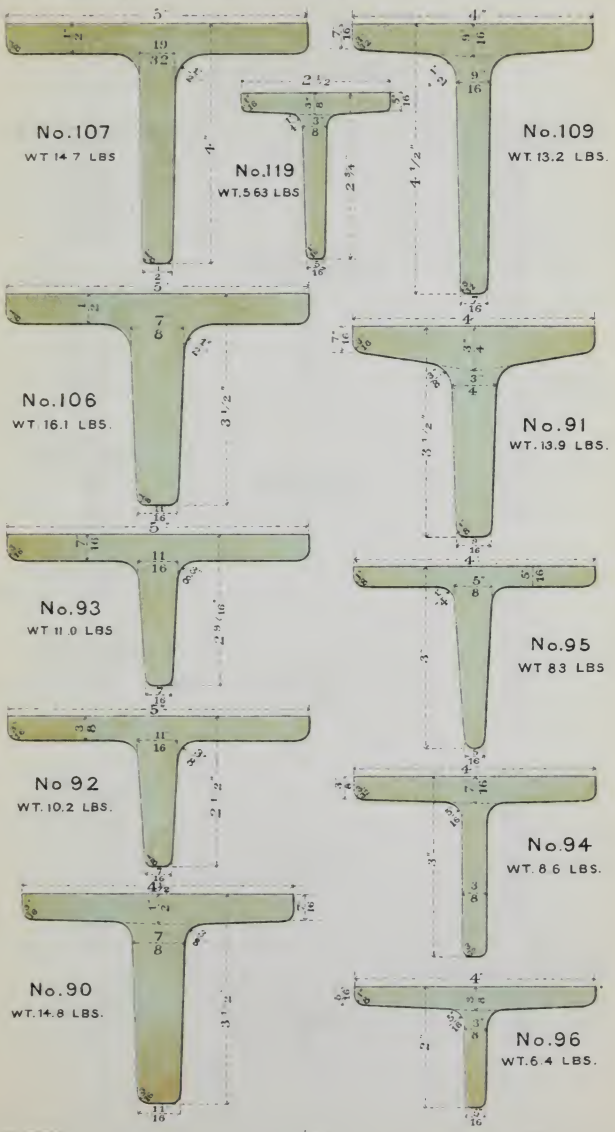
IRON OR STEEL

All weights given in lbs. per ft. for Iron. For Steel add 2 per cent.



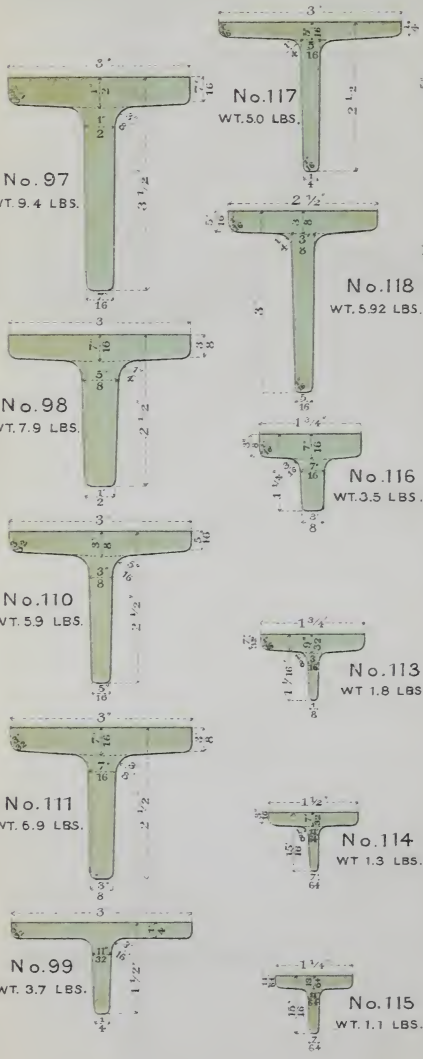
IRON OR STEEL

All weights given in lbs. per ft. for Iron. For Steel add 2 per cent.



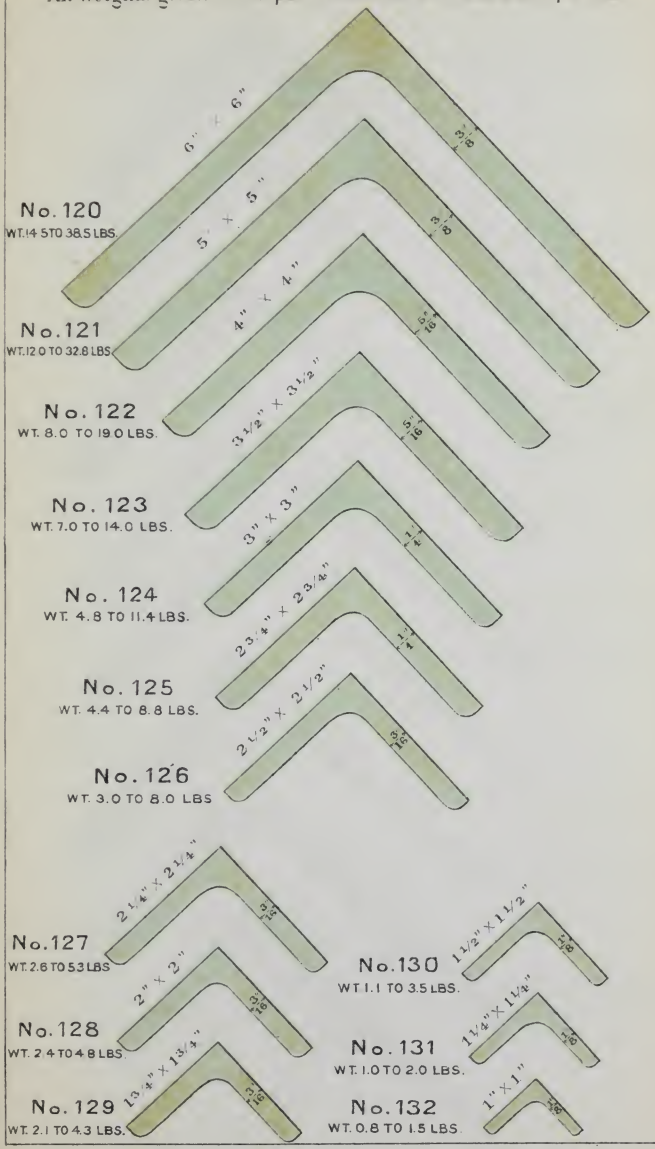
IRON OR STEEL

All weights given in lbs. per ft. for Iron. For Steel add 2 per cent.



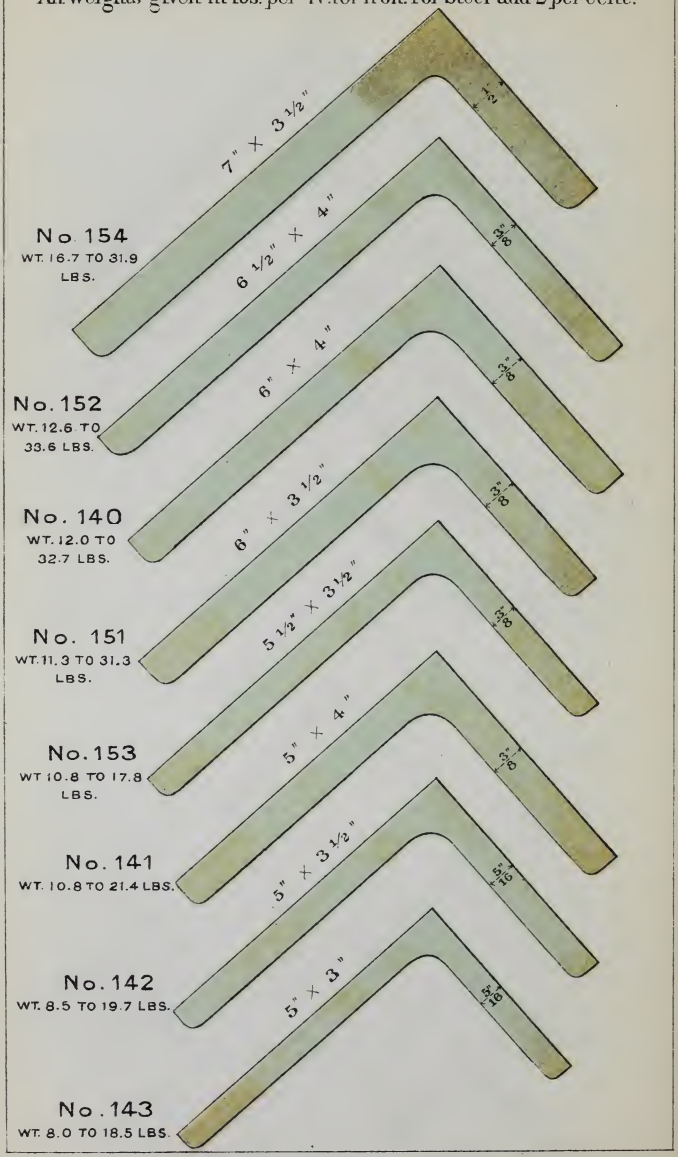
IRON OR STEEL

All weights given in lbs. per ft. for Iron. For Steel add 2 per cent.



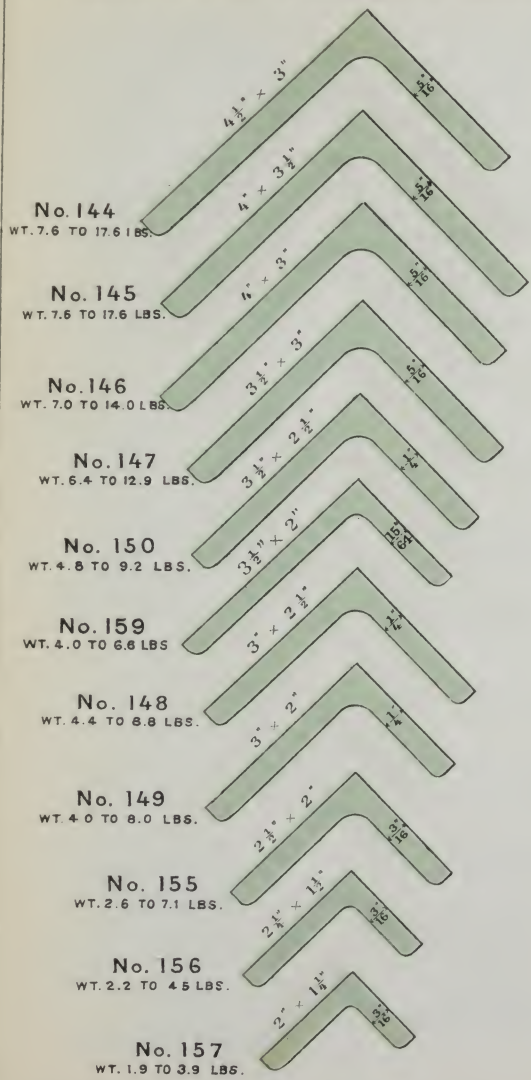
IRON OR STEEL

All weights given in lbs. per ft. for Iron. For Steel add 2 per cent.



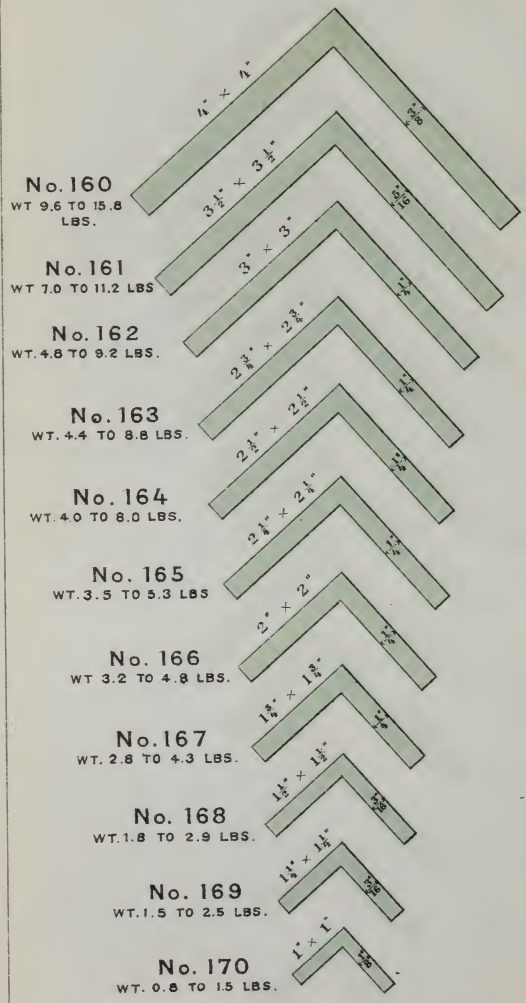
IRON OR STEEL

All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent



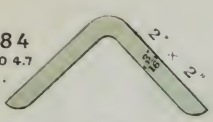
IRON OR STEEL

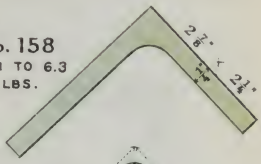
All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent

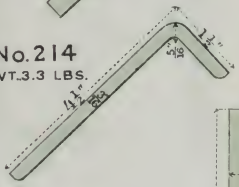


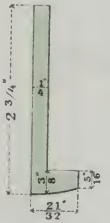
IRON OR STEEL

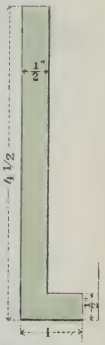
All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent

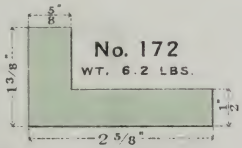


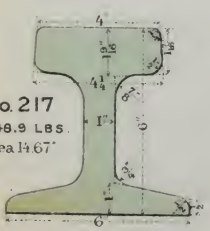


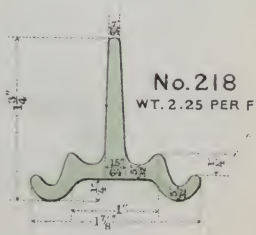






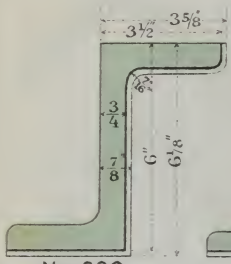






IRON OR STEEL

All weights given in lbs. per ft. for Iron. For Steel add 2 per cent

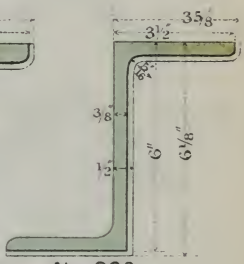


No 230

WT. 28.8 TO 33.9 LBS.

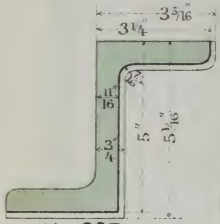
No. 229

WT. 22.3 TO 27.5 LBS.



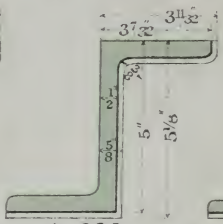
No. 228

WT. 15.3 TO 20.6 LBS.



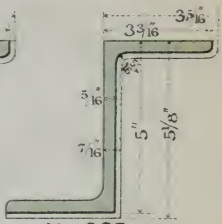
No. 227

WT. 23.2 TO 25.5 LBS.



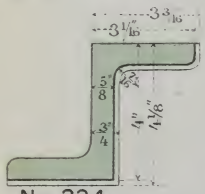
No. 226

WT. 17.4 TO 22.0 LBS.



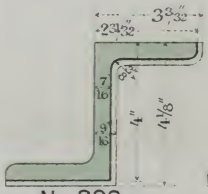
No. 225

WT. 11.2 TO 15.8 LBS.



No. 224

WT. 18.4 TO 22.5 LBS.

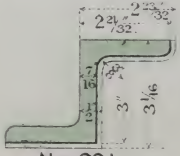


No. 223

WT. 13.2 TO 17.2 LBS.

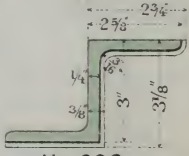
No. 222

WT. 7.7 TO 11.7 LBS.



No. 221

WT. 10.9 TO 12.5 LBS.

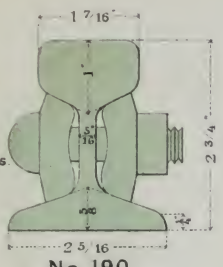


No. 220

WT. 6.5 TO 9.8 LBS.

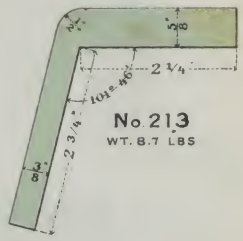
IRON OR STEEL

All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent

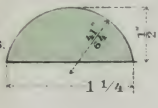


No. 191
WT. 1.7 LBS.

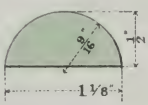
No. 190
WT. 8.3 LBS.



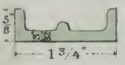
No. 213
WT. 8.7 LBS



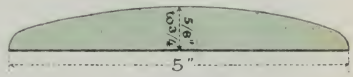
No. 194
WT. 1.6 LBS.



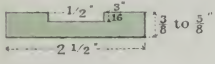
No. 193
WT. 1.4 LBS.



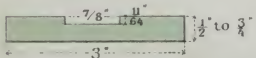
No. 195
WT. 1.2 TO 1.4 LBS.



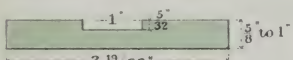
No. 212
WT. 8.0 TO 10.3 LBS.



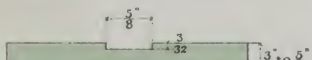
No. 196
WT. 2.8 TO 4.9 LBS.



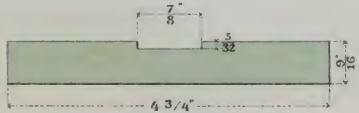
No. 197
WT 4.5 TO 7.0 LBS.



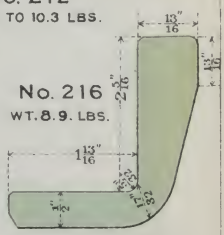
No. 198
WT. 7.0 TO 11.5 LBS.



No. 204
WT 4.2 TO 7.1 LBS.



No. 205
WT 8.5 LBS.

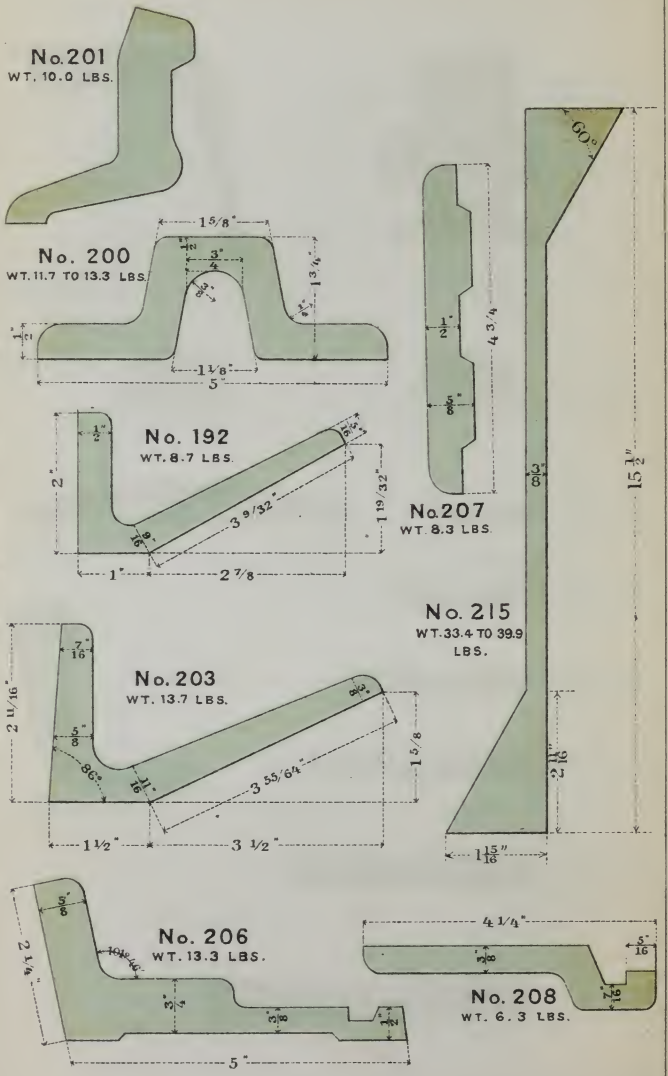


No. 216
WT. 8.9. LBS.

Plate No. 37.

IRON OR STEEL

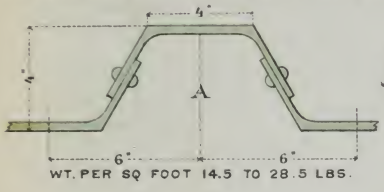
All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent



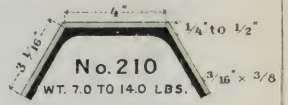
Trough Shaped Sections for Corrugated Flooring

IRON OR STEEL

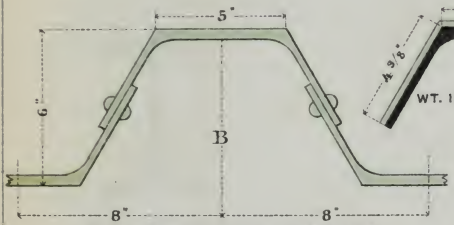
All weights given in Lbs. per ft. for Iron. For Steel add 2 per cent.



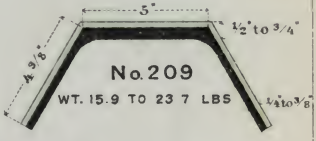
WT. PER SQ FOOT 14.5 TO 28.5 LBS.



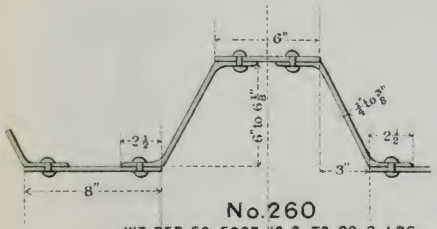
WT. 7.0 TO 14.0 LBS.



WT. PER SQ. FOOT 24.8 TO 36.6 LBS.



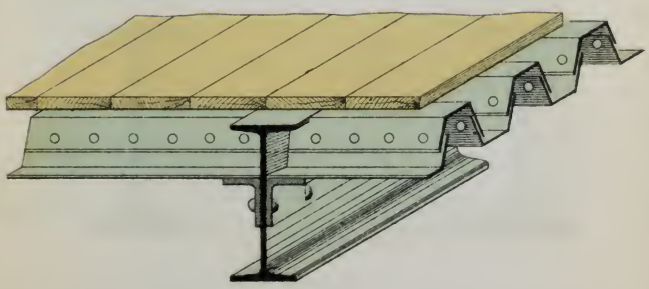
WT. PER SQ FOOT 15.9 TO 23 7 LBS



No. 260

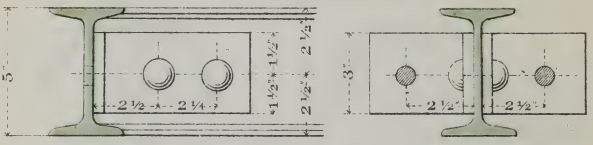
WT. PER SQ FOOT 19.6 TO 39.3 LBS.

WT. PER FT. 9.6 TO 14.4 LBS.

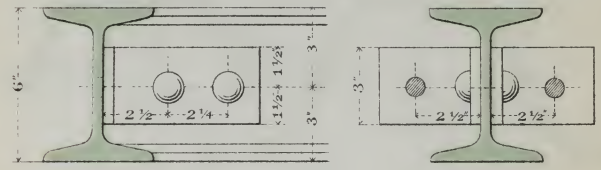


Standard Framing of Pencoyd Beams

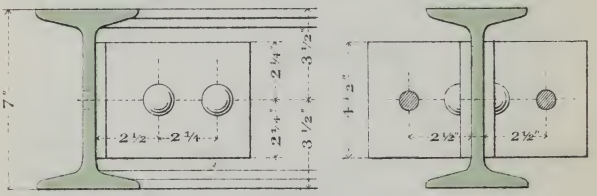
2 Angles 6″ × 4″ × 7/16″ 3″ long



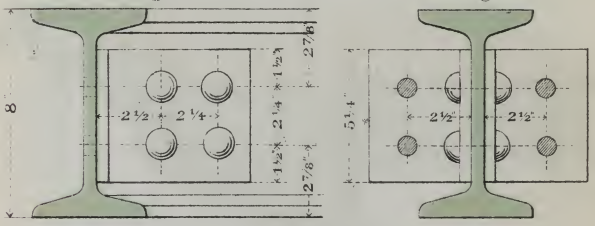
2 Angles 6″ × 4″ × 7/16″ 3″ long



2 Angles 6″ × 4″ × 7/16″ 4½ long



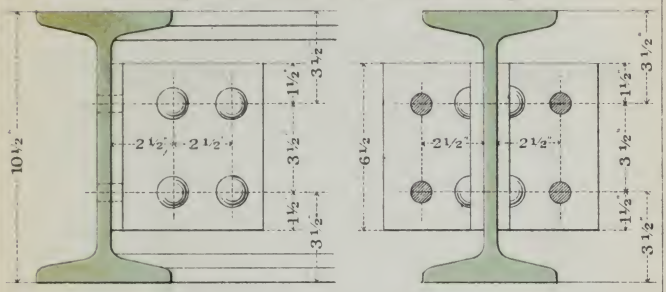
2 Angles 6″ × 4″ × 7/16″ 5¼″ long



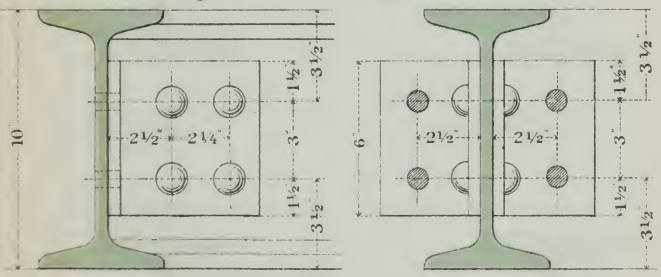
All holes 13/16″ All rivets 3/4″

Standard Framing of Pencoyd Beams

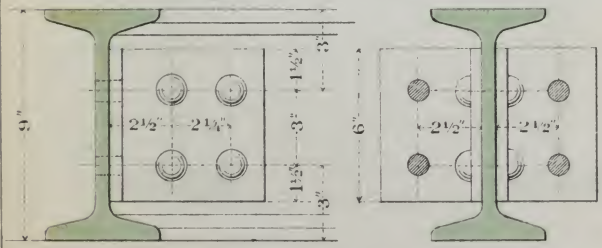
2 Angles 6" × 4" × 7/16 6½" long



2 Angles 6" × 4" × 7/16" 6" long



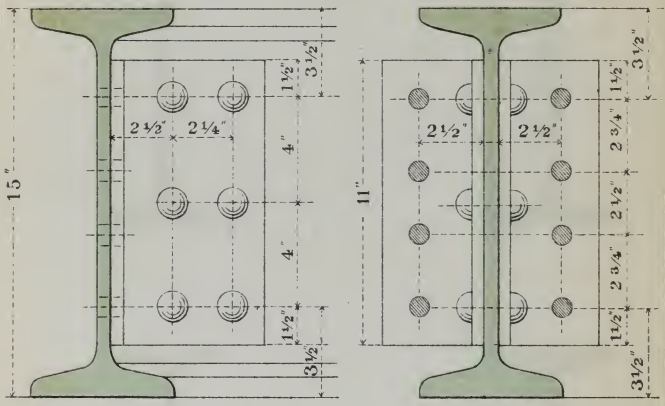
2 Angles 6" × 4" × 7/16 6" long



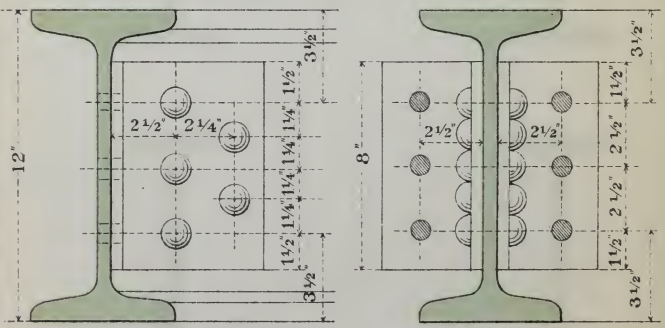
All holes 13/16" All rivets ¾"

Standard Framing of Pencoyd Beams

2 Angles 6″ × 4″ × ½″ 11″ long

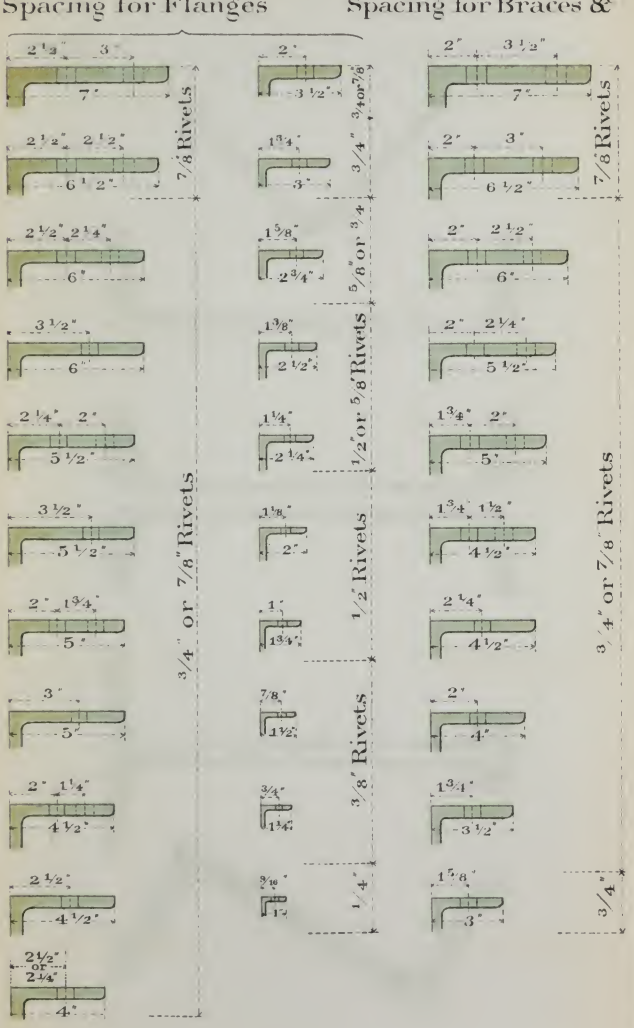


2 Angles 6″ × 4″ × ½″ 8″ long



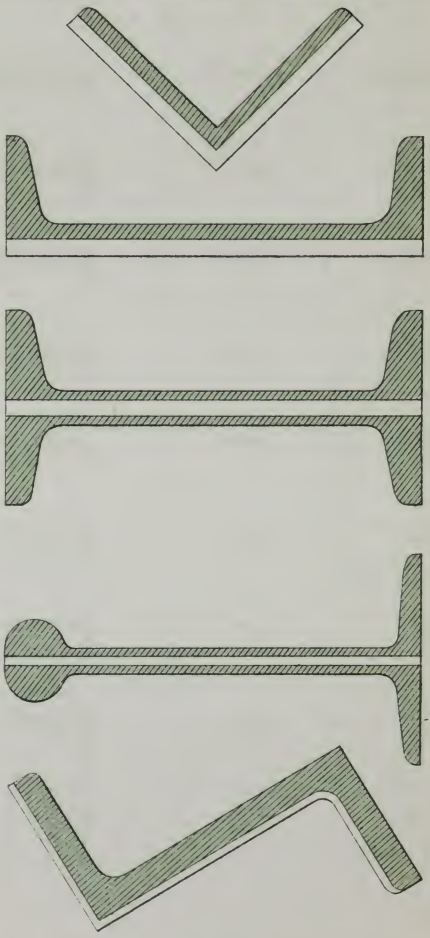
All holes 13/16″ All rivets ¾″

Rivet Spacing in Pencoyd Angles



METHOD OF INCREASING SECTIONAL AREAS.

Cross hatched portions represent the minimum sections and the blank portions the added areas.



All weights given in pounds per foot.